A Unified Theory of Knowledge

With Thanks

To the insects of my yard, my fellow humans, pet axolotl,
goldfish, quails, guinea pigs and dog,
You gave me insights on what it means to be sapient,
To Vernor Vinge for ideas on transcendence in "A Fire Upon The Deep",
And to the other memes which made all of this possible.

A Unified Theory of Knowledge
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Foreword

What stimulated me to write the UTK? In some respects it's been a desire to impose a practical framework for working with data, information, knowledge and wisdom. I do a lot of work with "reporting systems", and the conceptual management of these is critical. My past includes a degree in biology and a graduate diploma in "Information Systems", and I credit these with a deep-rooted desire for "big-pictures" based on disciplined thinking and general principles.

A family member completed a course recently in "knowledge management" (librarianship by any other name). Its content interested me, particularly the range of subjects which the course organizers thought were essential for the modern "knowledge manager". I concluded that the course was okay for providing the skills needed to get employment, but it was very light on theory, lacked cohesiveness and it did not provide any sense of a 'big picture' for knowledge. Unfortunately this criticism is not specific to the course: Internet sources and literature usually relegate knowledge to sub-concept roles and narrow context. And some of it is bad: I still shudder in memory of some of the speculative philosophy, religious and jargon-riddled "technical" literature I've read.

For some years now I've also struggled to keep track of my electronic files. Just like a library that provides indexes and catalogues for its materials, and allows browsing of books on its shelves, I needed an electronic equivalent. After some research I adopted the Dewey Decimal Classification system because it is used in libraries around the world and because it easily translated into a hierarchy of computer folders or directories. I also began a project to "improve" the logical structure of the system I was building and settled on an object-oriented approach that stretched my thinking along lines I've detailed in the following chapters.

I wondered: Are there fundamentals which apply to all knowledge? Can there be a unified view of knowledge? Just as physicists are pursuing a "theory of everything", is there something similar for knowledge – like a "Unified Theory of Knowledge"? It's clear that there are common principles and widely accepted ideas which could form the basis of a theory. We have time-proven classification systems, which mostly work, and there are many ideas and concepts from other disciplines which seem to be useful. Perhaps the basic ingredients for a unified theory of knowledge are with us today, lacking only structure? To this end the rest of the document is devoted.

At the risk of offending professional epistemologists I humbly submit this Unified Theory of Knowledge. The practical realities of circumstance, ability, family and work mean that my efforts will be less than what a professional could achieve, but I believe that the notion of a unified theory of knowledge, and the implications of such a thing, have great merit and may help those who are better placed to advance its ideas further.

Finally, most authors of research papers and scientific articles are sloppy in their use of words like intelligence, data, information and knowledge. The term "knowledge" is subject to a lot of abuse in common conversation and it is unfortunate that so many so-called “knowledge workers” are nothing of the sort. I’m hoping my work goes some way in encouraging others to be more precise and accurate in their use of these terms.

Peter Macpherson
February 2007

Table of Contents

Foreword 3
Table of Contents 5
Abstract 6
Overview 7
Reference List and Diagrams 9
  List of Brain Types 9
  List of Intellect Levels 9
  List of Conceptual Levels 9
  List of Principles 9
  The first 3 Levels of the Conceptual Hierarchy 9
Part 1 12
  Chapter 1: Framework for a Unified Theory of Knowledge 13
    Points on Memory 27
    Points on contemporary computer databases 28
  Chapter 2: The Bit 29
  Chapter 3: Data 31
    Do Plants and Protozoa Have Intellect? 33
    Human Technology with Intellect 33
  Chapter 4: Information 34
    Do Plants and Protozoa Have Instinctual Intellect? 36
    Human Technology with Instinctual Intellect 36
  Chapter 5: Knowledge 37
    Concept Ecosystems 40
  Chapter 6: Wisdom 42
    Concept Ecosystems at the wisdom level 45
    Using the external world to extend intellect 45
  Chapter 7: Transcendent Wisdom 47
    Concept Ecosystems at the Transcendent level 50
    Using the external world to extend Transcendent Intellect 50
  Chapter 8: Polycendent Wisdom 51
    Concept Ecosystems at the Polycendent level 52
    Using the external world to extend Polycendent intellect 52
  Chapter 9: Omnicendent Wisdom 53
    Concept Ecosystems and extensions of intellect 54
  Chapter 10: A comparison of intellectual levels 55
  Chapter 11: Other Considerations - Meme Intellects 58
Part 2 63
  Chapter 12: Introduction to the Conceptual Hierarchy 64
  Chapter 13: High level structures 66
  Chapter 14: Low level structures of memory 75
  Chapter 15: Low level structures for intellectual processes 81
Afterword 88
Glossary of Terms 90
Selected Reading and References 96

Abstract

The Unified Theory of Knowledge (UTK) concerns knowledge and places it in a framework linking brains, intellect and concepts. Depending on the level of conceptual complexity that an intellect operates at, there is reactionary behavior, instinctual behavior, intelligence, sapience or wisdom. Concepts such as fact, truth, certainty, anticipation and precognition are incorporated as “value ranges” within the levels.

The UTK aims to bring together and provide structure for the elements of knowledge. It imposes constraints on the use of common terms, but in doing so provides a progressive model for intellect and conceptual complexity. Conceptual ecologies, memes, meme complexes and meme-intellects are included in the theory.

The UTK has 2 parts: A Conceptual Framework and a Conceptual Hierarchy. The conceptual framework is an adaptation of the “DIKW” model. The conceptual hierarchy is similar to a library classification system that integrates the conceptual framework. The hierarchy abstracts to a single concept referred to as the “known universe”.

The word “knowledge” has two definitions in the UTK. In the first definition knowledge is a generic term *for anything that brains devote memories and processing activity to*. The second definition is more precise and refers to *a level of conceptual complexity that sits above that of “information” and below that of “wisdom”* (knowledge in this context is referred to as structured information).

Brains process sensory information, memories and internal signals. This processing is referred to as intellect. Memories plus the structured and codified signals used by intellect are referred to as concepts. Conceptual complexity, intellect and brains are the three key aspects of the general framework. Eight levels are defined for the framework, for what is assumed to be a continuous series that ranges from a zero state to an infinite state. Human intellect has been placed in the fifth level.

A biological basis for intellect is implicit in the UTK, but the theory also accommodates non-biological mechanisms and processes.

Keywords
Unified Theory of Knowledge, UTK, Concepts, Conceptual Hierarchies, Intellect, Data, Information, Knowledge, Wisdom, Transcendent, Polycendent, Omnicendent, Instinctual, Intelligence, Sapience, Concept Ecologies, Memes, Meme Complexes, Meme Intellects.

Overview

The Unified Theory of Knowledge (UTK) imposes constraints on the use of common terms and labels, but in doing so provides a progressive model for intellect and conceptual complexity. The model aims to:

- Bring together, and provide structure for, the elements of knowledge
- Link the elements of knowledge to intellect and link them to brain types found in the natural world
- Provide a model that links intellect to knowledge classification

Brains are physical objects whose internal processes and functions are collectively known as intellect. Any component of intellect that comprises one or more sets of structured and codified signals is variously called a concept, idea or thought. Ideas and thoughts tend to be terms reserved for human intellect, so the term concept is favored in the UTK.

Concepts are representations of the world around us. Concepts can be associated with memories and other concepts. The complexity of concepts is directly related to intellect: By grading brain, intellect and conceptual complexity into levels, terms such as information, knowledge and wisdom can be used consistently. The result is a model which is also similar to the physical-world of sub-atomic particles, atoms, molecules, compounds and objects. The levels used in the UTK are based on the DIKW (Data, Information, Knowledge, and Wisdom) hierarchy and relate to:

- Bits
- Data
- Information
- Knowledge
- Wisdom (in 4 levels)

The UTK depicts knowledge as groups of one or more concepts arising from combinations of one or more “Bits”, “Objects” and “Processes”. The “building block” in this model is the “Bit”, which is a structured and codified signal arising from processing of raw sensory signals. With this in mind, two definitions are put forward for the term knowledge. The first recognizes the importance of signal processing in brains in the creation of knowledge and the second follows popular view that knowledge is made of bits, data and information organized to a certain level of conceptual complexity.

Definition 1

In the first definition, knowledge is a generic term *for anything that brains devote memories and processing activity to*. These processing activities produce personal and social forms of knowledge. For the UTK, personal knowledge is referred to as the knowledge held in an individual’s brain and social knowledge is the adaptation and reproduction of personal knowledge into forms that can be communicated to others.

Personal knowledge comprises:

- Sensory input
- Memories
- Concepts remembered[1]
- Awareness of processes occurring in the brain
- Awareness of self and personal states
- Remembered sequences of muscle activity.

Social knowledge covers any form of communication between creatures with intellect. It includes:

- Sound and speech
- Smell
- Body language
- Body shape and color
- Visual products/objects
- Aural products/objects
- Written products/objects

Scents, sounds, visual appearance, written words, pictures and dance are common examples of social knowledge. Such things can be ephemeral or long-lasting.

Social knowledge is also static or dynamic. The term “static” is used in the sense of a communication that does not change (such as a photograph). The term “dynamic” is used in the sense of communications that change as they occur. Television, radio, multimedia, plays, dance and concerts are examples of dynamic communications.

All social knowledge comprises “packaged concepts” intended for an existence external to the brain which creates them. The term “meme” is commonly used to describe one or more sets of packaged concepts.

Definition 2

For the second definition of knowledge it has a precise meaning as *the product of structured information*. It is a level of conceptual complexity within the Unified Theory of Knowledge that sits above information and below wisdom.

This document is written in 2 parts. Part 1 is the general framework of the UTK and part 2 is a related classification scheme based on a hierarchy of concepts. Readers will find it useful to refer to the reference lists and diagrams overleaf.

---

[1] Concepts, memories, relationships between these, and signals destined to control muscles (and organs) are common products of processing activity.

Reference List and Diagrams

List of Brain Types

1. Non-brain (e.g. virus)
2. Neural net (e.g. jellyfish)
3. Simple (e.g. Insect)
4. Complex (e.g. Dog)
5. Sapient (e.g. Human)
6. Level 6 brain
7. Level 7 brain
8. Level 8 brain

List of Intellect Levels

1. Non-intellect
2. Reactionary
3. Instinctual
4. Intelligent
5. Sapient
6. Transcendent
7. Polycendent
8. Omnicendent

List of Conceptual Levels

1. Bit
2. Data
3. Information
4. Knowledge
5. Wisdom
6. Transcendent Wisdom
7. Polycendent Wisdom
8. Omnicendent Wisdom

List of Principles

- Intellect relates to processing ability, rather than senses.
- The limits and nature of knowledge changes with intellect.
- Information has relationships, data does not. Each level of the UTK comprises the structured products of lower levels.
- Processes for brains, intellect and knowledge do not require an organic basis of operation.

The first 3 Levels of the Conceptual Hierarchy

- The Known Universe
  - Forces
    - Electromagnetic
    - Gravitational
    - Strong
    - Weak

- Constants
    - Large space constants (astronomical)
    - Medium space constants (general physical)
    - Small space constants (atomic/subatomic)
    - Mathematical
- Objects
    - Objects of the physical world
    - Object interactions (processes and systems)
    - Objects of the intellect

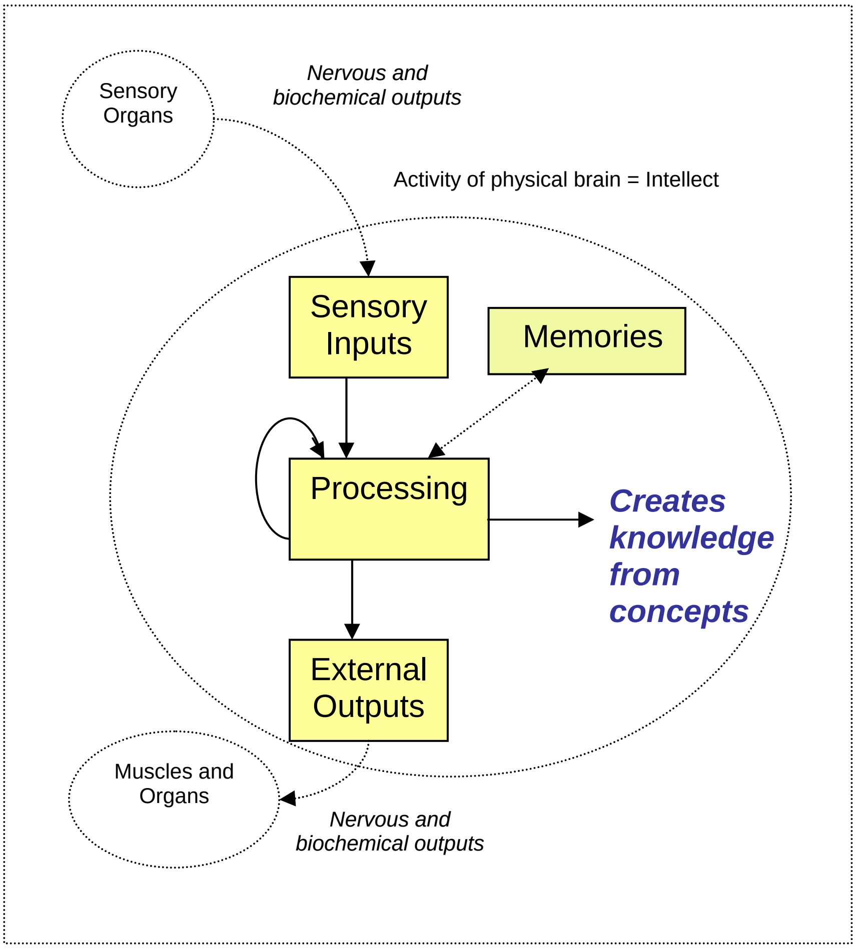
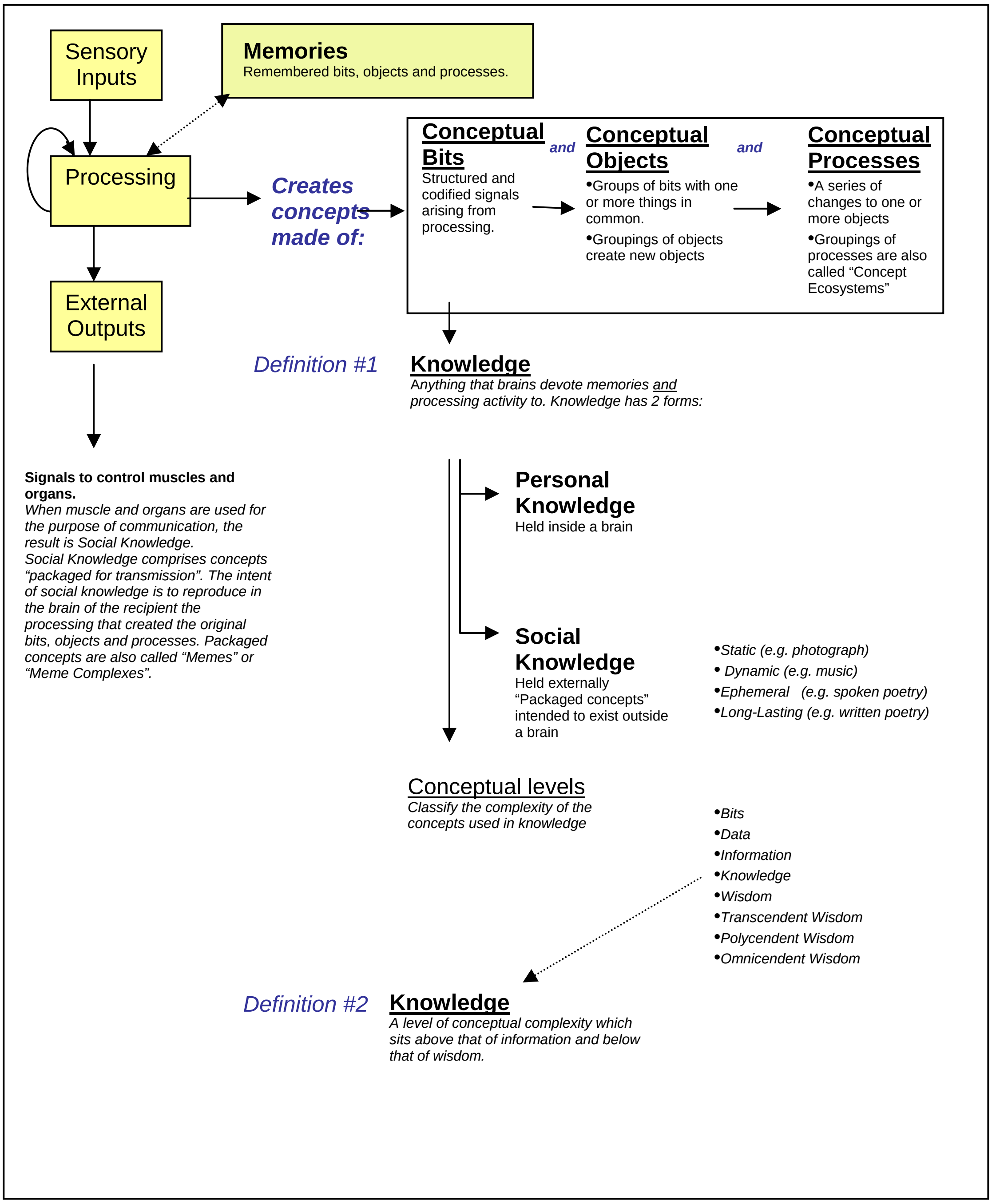

Sensory Organs
Nervous and biochemical outputs
Activity of physical brain = Intellect
Sensory Inputs
Memories
Processing
Creates knowledge from concepts
External Outputs
Muscles and Organs
Nervous and biochemical outputs

Diagram 1: Broad Relationships



Memories Remembered bits, objects and processes.

Conceptual Bits Structured and codified signals arising from processing.

Conceptual Objects
- Groups of bits with one or more things in common.
- Groupings of objects create new objects

Conceptual Processes
- A series of changes to one or more objects
- Groupings of processes are also called "Concept Ecosystems"

Definition #1 **Knowledge** *Anything that brains devote memories and processing activity to. Knowledge has 2 forms:*

Signals to control muscles and organs. *When muscle and organs are used for the purpose of communication, the result is Social Knowledge. Social Knowledge comprises concepts "packaged for transmission". The intent of social knowledge is to reproduce in the brain of the recipient the processing that created the original bits, objects and processes. Packaged concepts are also called "Memes" or "Meme Complexes".*

Personal Knowledge Held inside a brain

Social Knowledge Held externally "Packaged concepts" intended to exist outside a brain

- *Static (e.g. photograph)*
- *Dynamic (e.g. music)*
- *Ephemeral (e.g. spoken poetry)*
- *Long-Lasting (e.g. written poetry)*

Conceptual levels *Classify the complexity of the concepts used in knowledge*

- *Bits*
- *Data*
- *Information*
- *Knowledge*
- *Wisdom*
- *Transcendent Wisdom*
- *Polycendent Wisdom*
- *Omnicendent Wisdom*

Definition #2 **Knowledge** *A level of conceptual complexity which sits above that of information and below that of wisdom.*

Diagram 2: Detailed Relationships

Part 1

The UTK has a Conceptual Framework and a Conceptual Hierarchy. The conceptual framework is an adaptation of the “DIKW” model and is covered in part 1 of this document. The conceptual hierarchy is addressed in part 2 and integrates the conceptual framework into a hierarchy of concepts that abstract to the “known universe”.

Chapter 1: Framework for a Unified Theory of Knowledge

The Unified Theory of Knowledge is abbreviated to UTK in this document.

If a creature has an organ called a brain, or has brain-like functions, then the normal operation of this brain is referred to as intellect by the UTK[2]. In the animal kingdom there is great diversity in brains, and brain functions, but from a functional point of view, all brains have specialized areas for:

- Sensory input;
- Maintaining body states;
- Processing and utilizing sensory input
- Doing things with the outputs of processes (muscle and organ control for moving, talking, eating etc.).

Complex brains differ most from simple brains by having larger areas devoted to processing and utilization of sensory input. It's these functions that the UTK concentrates on.

The sensory organs of creatures, which are the basis of sensory input, utilize visual, tactile, auditory, electrical, magnetic, gravitational (sense of balance) and chemical (taste and smell) mechanisms. Sensory organs can be complex and they can provide sophisticated pre-processing of sensory signals, but most activity occurs within the brain itself. There is a general principle in nature that expansion of intellect does not require corresponding increases in the range, scope or sensitivity of the senses:

Principal No 1: Intellect relates to processing ability, rather than senses.

The processing abilities of most creatures include:

- Sensory interpretation,
- Making and retrieving memories,
- Pattern recognition
- Associating (and relating) sensory inputs and memories
- Structuring of sensory inputs and memories
- Labeling/codifying sets of memory and sensory input
- Inherited mechanisms (instincts and "biological clocks")

The brain functions associated with outputs generally use mechanisms that either contract muscles, produce chemicals or stimulate organs. As a result of muscle contractions and suchlike, a creature exhibits observable behavior.

Simple brains are (small) groups of specialized cells that receive outputs from sensory cells, do something with these inputs and then stimulate the activity of other cells.

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[2] Intellect is sometimes used in a limited sense to refer human brain function, but the term is useful for the entire range of brains found in the animal kingdom.

Often the chain of (electrical) signals involves a small number of neurons. A simple insect brain of several thousand neurons, for example, might only be capable of seeking food, fleeing predators and identifying mates.

Complex brains generally have sensory organs that do some “pre-processing” of sensory input, but most activity occurs in the brain itself via many neuronal processes executing simultaneously. Whilst a complex brain can have the same basic mechanisms for inputs and outputs as a simple brain, what it does in-between is very different. It’s common to talk about “higher-order brain functions” that distinguish complex from simple brains. Features of complex brains are:

- Long-term memory
- Complex pattern recognition
- Awareness of body states (hunger, thirst etc)
- Communication
- Anticipation
- Problem solving
- Observation
- Interpretation
- Association
- Deduction
- Inference
- Simulation

Complex brains also have the abilities to anticipate events and engage in social interactions. At one point or another, brains are complex enough to “think” – to utilize abstracts of remembered sensory inputs, apply (complex) concepts and create a narration. To narrate is to tell stories about objects and processes - by art, voice, written, symbolic and other means[3]. Verbal narration is dominant in humans and we often use the term “thinking” to refer to our ability to speak “inside our head”.

Brains are physically limited in size and functions so intellect, the normal operation of brains, is constrained by these physical limits[4]. In accordance with the range of brains found in the animal kingdom, there is also a range of intellects and it is useful to group them into a series of levels that range from simple to complex.

“Ideas” and “thoughts” are also associated with intellect, but they are terms usually restricted to human intellect, so the term “concepts” is favored to cover the products intellect across the entire animal kingdom. In the UTK the complexity of concepts is assumed to be directly related to the complexity of intellect, which in turn is related to the complexity of brain. Concepts relate to real or imagined:

- Objects
- Processes and activities
- Systems (any groupings of objects and processes)

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[3] The entire scope of art and language including pictures, sculptures, dance and fashion are considered as forms of narration.

[4] This point does not relate to physical size of brains, rather the number, scope and variety of brain areas and processes.

- Actions
- Relationships

The term "concept" is used in a very broad sense in the UTK, but it is a critical component of the theory. Raw sensory signals do not define a concept, but when they are structured and codified, the resulting conceptual "Bits" become the building-blocks of concepts. Sets of bits become "Conceptual Objects", and when one or more "Objects" interact with each other the result is a "Conceptual Process". "Bits", "Objects" and "Processes" (and combinations of these) therefore constitute all known concepts.

"Bits" alone provide simple concepts such as that of redness - a particular set of structured and codified sensory signals relating to the color red. The concept of a "dog" is more complex and it is an "Object" comprising many sets of structured and codified sensory signals. The concept of ageing is a "Process" that involves objects changing over time.

It is also important to remember that most processes inside the brain which are involved in structuring and codification of signals operate at varying levels of efficiency, tending to the abstraction of input signals and the dropping of extraneous components. Other processes that later interpret and do things with concepts will "fill in the gaps" (according to need) using interpolative and extrapolative mechanisms[5]. This view of "concept" fits in well with the ideas on inference (deductive and inductive forms) in classical commentaries on knowledge: The quality and nature of inference, certainty and precision are affected by the quantity and quality of sensory signals, plus the efficacy of processes that process these into concepts, then those processes that make use of the concepts.

The UTK depicts knowledge as groupings of one or more concepts arising from combinations of one or more "Bits", "Objects" and "Processes". With this in mind, two definitions are put forward for the term knowledge. The first recognizes the importance of signal processing in brains in the creation of knowledge and the second follows popular view that knowledge is made of bits, data and information organized in levels of conceptual complexity.

Definition 1

> In the first definition, knowledge is a generic term *for anything that brains devote memories and processing activity to*. These processing activities produce personal and social forms of knowledge. For the UTK, personal knowledge is referred to as the knowledge held in an individual's brain and social knowledge is the adaptation and reproduction of personal knowledge into forms that can be communicated to others.

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[5] Take for example how a human face is remembered by the brain. Instead of an accurate "bit-map" being recalled from memory, distinguishing features are recalled and an image of the face is re-constructed.

Personal knowledge comprises:

- Sensory input
- Memories
- Concepts remembered[6]
- Awareness of processes occurring in the brain
- Awareness of self and personal states
- Remembered sequences of muscle activity.

Social knowledge covers any form of communication between creatures with intellect. It includes:

- Sound and speech
- Smell
- Body language
- Body shape and color
- Visual products/objects
- Aural products/objects
- Written products/objects

Scents, sounds, visual appearance, written words, pictures and dance are common examples of social knowledge. Such things can be ephemeral or long-lasting.

Social knowledge is also static or dynamic. The term "static" is used in the sense of a communication that does not change (such as a photograph). The term "dynamic" is used in the sense of communications that change as they occur. Television, radio, multimedia, plays, dance and concerts are examples of dynamic communications.

All social knowledge comprises "packaged concepts" intended for an existence external to the brain which creates them. The term "meme" is commonly used to describe one or more sets of packaged concepts.

Definition 2

In the second definition, knowledge has a precise meaning as *the product of structured information*. It is a level of conceptual complexity within the Unified Theory of Knowledge that sits above information and below wisdom.

When concepts are expressed in words, pictures, actions or by other means, this is referred to as "packaging". Packaged concepts are usually intended for use by other intellects[7] ("cultural transmission") and once created they often "have a life of their own". The biological analogies are many and they were first explored by Richard Dawkins in his book "The Selfish Gene" (1976). Richard used the term "Meme" to emphasize the similarities he found with gene behaviors (such as self-replication, mutation, life-cycles and competition). Since then many other authors have contributed to the "science of mimetics".

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[6] Concepts, memories, relationships between these, and signals destined to control muscles (and organs) are common products of processing activity.

[7] The UTK recognises that although cultural transmission is usually species-specific, numerous examples exist of trans-species exchange of concepts.

For the purposes of the UTK, memes are considered to be one form of social knowledge and meme complexity and/or sophistication is assumed to be directly related to the conceptual level from which they originate. The scope and extent of utilization of memes also depends on intellect. Intellect uses memes:

- To aid survival, health and comfort
- For reproductive advantage
- For communication with other intellects
- For indirect control of other intellects
- To Influence events
- To Influence perceptions and attitudes
- To destroy and change other memes
- To create new memes
- To self-reinforce, train self and to reestablish concepts in self.

Some proponents of mimetics say memes are like parasites or viruses that infect and influence their hosts in varieties of ways. Darwinian principles are also claimed to apply, resulting in adaptation, evolution, devolution etc of memes. This is a useful analogy and it emphasizes the viewpoint of memes using intellects rather than intellects using memes. In a life-like analogy, memes can influence and use intellect:

- To produce more memes
- To store memes
- To promote reproduction of hosts to produce offspring that are "friendly" or "susceptible" to memes
- To decrease reproductive opportunity, health and comfort of intellects which are not "friendly" or "susceptible" to memes

The interdependence of intellect and memes also favors symbiotic arguments, or possibly arguments for commensalisms, however another biological analogy exists in which intellects are like neurons, and memes are the signals that travel between them. This analogy is favored in the UTK and gives rise to the idea that groups of intellects (neurons) and their memes ("signals") can collectively operate as intellects[8].

Memes tend to be homogenous in transmission, but intellects can interpret and use them in different ways. The translation steps in brains which re-create the concepts will vary from brain to brain, as will the importance, and other associations, assigned to them: Two people can agree on the concept of the planet earth orbiting the sun for example, but internally their mental processes responsible for the structuring and codifying of signals into the concept might be very different.

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[8] This idea is further explored in chapter 11.

Within any intellect, concepts are in a dynamic state – concepts are created, copied, changed, merged, deleted, interact with, and are associated with others. These behaviors are very similar to those of memes; however concepts don't have to be self-replicating. In summary:

Concepts = Structured and codified signals
Memes = Concepts packaged for other intellects.

The UTK refers to intellect as the product of functioning brains, and knowledge as one of the products of intellect like so:

Brain ---------------> Intellect ---------------> Knowledge
(Physical substrate) (Processes and memory) (Applied Intellect)

Thus brains are referred to as the physical substrates whose mechanisms, memories and processes produce intellect. There products of intellect include memories, signals used to control organs and muscle movement, information, knowledge and wisdom.

Since intellect is constrained by the physical aspects of brains, the knowledge of an individual creature, or group of creatures, must be affected by these limits. This is particularly so for personal knowledge, but less so for social knowledge[9] . Limits to knowledge (which a creature, or group of creatures, has) depends on the complexity and sophistication of their intellect, giving another general principle:

Principal No 2: The limits and nature of knowledge changes with intellect.

It also is postulated that brain, intellect and knowledge have fixed relationships throughout an exponential curve that ranges from zero to infinity[10]. This means that as physical brains increase in measured functional attributes (not size), measured intellect and measured knowledge also increase, and the reverse is true. Any point on the curve would be several times greater in quantity, activity and complexity than lower points. Intellect and Knowledge share a further relationship in that Intellect can be regarded as applied[11] knowledge:

Applied
knowledge
Knowledge ---------------> Intellect

In this relationship, the extent to which knowledge is applied is a determination of intellect. Interestingly, intelligence tests last century relied on this: They utilized a large pool of knowledge to provide a ranking scale for intellect and assessed individuals in their abilities to apply knowledge.

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[9] Social knowledge has its own constraints and limits. In the example of a public library, there are limits accorded by the size of the building, shelf space and storage space, financial budgets, acquisition policy, and retention policy.

[10] Zero knowledge is assumed to be the lowest point in the series. Negative knowledge is an interesting idea, but this implies the unlikely situation of a brain of with negative functional characteristics and a negative intellect.

[11] The label "applied" denotes processes and activity. Examples are physical action, reasoning, puzzle solving, art, science, technology and mathematical calculations. A library of books contains a lot of knowledge, but it has no intellect.

Sometimes the terms “intellectual ability” and “intellectual capacity” are used to quantify intellect. These terms are not used in the UTK because of their subjective nature. Instead, a set of “operational levels” are said to have “operational components” which denote complexity and sophistication in Brain, Intellect and Knowledge:

	Brain	**Intellect**	**Knowledge**
Operational components:	• Physical descriptions • Speed of processing • Concurrency of processes • Creation of long-term memories etc.	• Cognitive abilities • Memory associations • Inference • Anticipation • Analysis etc.	• Concepts and their relationships • remembered procedures • remembered processes etc.

The UTK confirms and extends the ideas used by numerous authors since the late 1980’s[12]. Sometimes referred to as the “knowledge pyramid” or DIKW (Data, Information, Knowledge, and Wisdom) hierarchy, the ideas are popular with information technologists, especially proponents of “knowledge management”. In the hierarchy, lower elements combine in recursive fashion into higher elements:

{“Bits”➔”Data”➔”Information”➔”Knowledge”➔”Wisdom”}

Instead of using the term “pyramid” or “hierarchy”, the UTK uses the term “level”, but otherwise remains faithful to the DIKW sequence. Readers should note that the scope of the UTK is broader: Brain, Intellect, levels beyond wisdom, Conceptual Ecosystems and meme intellects are included in the UTK.

Eight operational levels have been developed in the UTK (human intellect has been placed in the middle level). Each level has greater complexity than its predecessor, and has more knowledge. This approach addresses the simple-to-complex brain types found in nature and provides a way to underpin terminology for intellect and the elements of knowledge.

It should also be noted that the first 5 levels cover the range of intellects found in nature and the 3 levels that follow extend the series beyond human intellect.

The challenge of incorporating traditional properties of knowledge such as “truth”, “certainty” and “accuracy” has been met by assigning these terms as “value ranges” for the knowledge components of the levels. Dogs, for example, have a complex brain able to produce an intellect that operates at the “intelligent” level. With knowledge produced at this level the value range of is said to vary between uncertainty to certainty: Dogs can understand things to be certain, uncertain or somewhere in-between, but dogs do not understand higher-level values such as “Truth”.

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[12] Nikhil Sharma, in an article on the internet dated December 2005 wrote on “The origin of the Data Information Knowledge Wisdom Hierarchy. http://www-personal.si.umich.edu/~nsharma/dikw_origin.htm. He wrote that the earliest references to DIKW are attributed to poetry by TS Eliot (the Rock (Faber & Faber 1934). Separately, authors including Jonathan Hey (2004) Russell Ackoff (1989), Milan Zelany (1987), Michael Cooley(1987) and Harlan Cleveland (1982) have promoted versions of the DIKY in recent decades.

Consistent with the scientific label of *Homo sapiens*, humans are located in the “Sapience” level of the UTK. At this level knowledge is complex enough to be classified as wisdom and values such as “Truth” are said to apply.

The 3 levels beyond human intellect were formulated on the premise that awareness of self and surroundings is a property of intellect and this property grows in scope as intellect increases Awareness applies only to immediate surroundings (and self) in the case of simple creatures, then to larger volumes of space/areas as intellect increases. This awareness is not only for the physical environment, but for the behaviors of other creatures, social interactions and external processes. Awareness also extends from a “here-and-now operational mode” in simple intellect to the anticipation of events and outcomes in complex intellects. The 3 levels beyond human intellect emphasize the anticipatory processes of intellect and exponential increases in the conceptual complexity of knowledge. They also follow the sequence of:

“Within systems”➔ “Across systems” ➔ “Across many systems”.

Each level of the UTK is assumed to use features, properties, functions and processes of lower levels[13]. This assumption is based on contemporary “evolutionary” thinking and a need for a “holistic” approach in describing intellect. The 8 levels of the UTK are summarized in the table overleaf:

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[13] An “onion-skin” diagram with exponentially thicker layers was considered for the commentary on the 8 levels, but this was too visually complex. Onion-skin models however have advantages in that each ring can be divided into wedges to depict functional areas, processes etc. These can then be clustered across layers to show how lower level processes and concepts contribute to higher levels.

	Brain		**Intellect**		**Knowledge**		**Features of intellect**
	Physical complexity	*Example*	*Intellectual complexity/processes*	*Description*	*Conceptual complexity/ level*	*Value Range Property and notes*	
1	Non-brain	Simple organisms such as bacteria	Non-intellect	• Structured and codified sensory signals of biochemical or electrical nature • Lacking a brain	Bit	Either absent (non-value) or present as a value, code or symbol. Bits convey simple concepts	• Zero
2	Neural net	Jellyfish	Reactionary	• Simple, stimulus-driven activity. • Action-reaction behavior. • Simple mental processes fixed by genome	Data	Inaccurate to Accurate. -Product of structured bits.	• Little or no memory. • Action –reaction mode of operation.
3	Simple	Insect	Instinctual	• Instinct-driven behavior. • “Hard-wired” neural pathways. • Complex mental processes fixed by genome. • Fixed repository of relationships used with concepts.	Information	Non-factual to Factual. -Product of structured data.	• Simple memory. • Simple learning. • Conceptualization of objects only.
4	Complex	Dog	Intelligent	• Intelligence – an awareness of self and non-self, with faculties for reasoning and complicated memories. • Possessing faculties for construction and self-	Knowledge	Uncertainty to Certainty -Product of structured information.	• Short and long-term memory. • Multi-step, complex learning • Conceptualization of objects and processes.

				modification of mental processes. • Able to formulate and construct new relationship with concepts			
5	Advanced	Human	Sapient	Sapience • Using language and tools • Perform complicated analysis and judgments	Wisdom	Non-Truth ("fictional") to Truthful -Product of structured knowledge	• Short-term memory and (large) long-term memories. • Complicated, many-step learning. • Conceptualization of objects, processes and simple systems.
6	Level 6 Brain	-	Transcendent	Transcendence • Abilities beyond what is considered "top of the range" for humans. • To be excellent in all things human and a genius in all endeavors.	Transcendent Wisdom	From non- anticipation to limited precognition -Product of structured wisdom.	• Short-term memory and (very large) long-term memories. • Complicated, many-step learning. • Conceptualization of objects, processes and complex interacting (small) systems.
7	Level 7 Brain	-	Polycendent	Polycendence (no examples)	Polycendent Wisdom	From limited to pervasive precognition. Product of structured Transcendent wisdom.	• Short-term memory and (very large) long-term memories. • Complicated,

							many-step learning. - Conceptualization of objects, processes and complex, interacting large systems.
8	Level 8 Brain	-	Omnicendent	Omniscience (no examples)	Omnicendent Wisdom	From non-omniscience to Omniscience. -Product of structured polycendent wisdom.	- Short-term memory and (very large) long-term memories. - Complicated learning. - Conceptualization of very large numbers of systems.

The UTK conceptual levels are best used as nouns in narration and can be alternatively represented like so:

1. Isolated Bits and sets of Bits
2. Structured Bits ➔Data[14]
3. Structured Data ➔Information
4. Structured Information ➔Knowledge
5. Structured Knowledge➔Wisdom
6. Structured Wisdom ➔Transcendent Wisdom
7. Structured Transcendent Wisdom ➔ Polycendent Wisdom
8. Structured Polycendent Wisdom ➔ Omniscience

And alongside these are the intellectual levels that refer to the real-world application of the conceptual levels.

1. Applied Bits ➔ Behavior without brain or nervous system
2. Applied Data ➔Reactionary behavior via (simple) brain or nervous system
3. Applied Information➔Instinctual behavior
4. Applied knowledge➔Intelligence
5. Applied Wisdom➔Sapience
6. Applied Transcendent Wisdom➔Transcendence
7. Applied Polycendent Wisdom ➔Polycendence
8. Applied Infinite Wisdom ➔ Omniscience

(In the chapters that follow, each level is discussed in detail)

Brains with more functions than human brains are not evident in the natural world so the UTK uses generic “Level n” labels for levels 6 to 8. In discussions on physical attributes, intellectual processes and concepts, the labels are useful descriptors: There are “instinctual processes”, “transcendent processes”, “informational concepts”, “knowledge-level concepts”, “simple brain structures” and so forth.

From level to level, the conceptual components combine in ways that are analogous to the physical world. In nature, subatomic particles combine to give atoms, atoms combine to give molecules, molecules to give compounds and so forth. Particles are the basic building blocks in the real world and the equivalent in the UTK are bits. Particles combine to form atoms and atoms combine to form molecules – bits combine to form data and data combines to form information. Larger aggregations follow this pattern.

Physical World Particle Class	**UTK conceptual level**
Subatomic particles (“electron”, “quark” etc)	*Bits*
Atoms	Data
Molecules*	Information
Compounds*	Knowledge
Objects*	Wisdom

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[14] Read as “Structured bits result in data”

System*	Transcendent Wisdom
Large Systems*	Polycendent Wisdom
Universe*	Omnicendent Wisdom

*Any molecule, compound, object or system that exists in the real world is notionally built on clusters of (many) smaller components in close proximity to each other, typically held together via electric field interactions and gravitation. The ongoing "stability" of objects and systems often require energy input. Change and disruption occur through:

- Unstable arrangements of atoms and molecules
- Cooling
- Heating
- Effects of electromagnetic fields
- Effects of gravitation,
- Influx or efflux of electrons
- Influx or efflux of other particles,
- Gross mechanisms like grinding, tearing, pressing etc.

The same can be said of concepts. The electric field interactions of the physical world are the relationships that intellect maintains between bits, data, information, knowledge and wisdom. Brains also provide the equivalence of gravitation - bits, data, information; knowledge and wisdom are "brought together" under their influence.

The physical proximity of atoms, molecules, compounds etc. have two equivalents in intellect:

- For reasons of economy, many memories and processes are shared[15]. This imposes "fixed relationships" and "when and how" conditions on the use of shared memory".
- Components are "closer or further away from each other according to where they are located in processing steps and where they are located in sequentially retrieved memories.

Relationships range from strong to weak in the sense that intellect places greater or lesser significance on them. This occurs for emotional reasons[16], survival reasons and for other reasons such as health, reproductive opportunity, social acceptance, personal gain etc. Many creatures have "hard-wired" repositories of relationships that have evolved over time. Complex brains with intellects operating at the intelligent level (and above) have additional ability to learn and develop new relationships.

The properties ("attributes") of relationships are:
- Assignation: Assigning one or more relationships to one or more of concepts. Fear association is an example of a "hard-wired" relationship and algebra is an example of a learnt relationship.

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[15] As an economical approach to physically limited resources, brain memory is a mixture of multi-use and specific memories.
[16] Fear, hate, love and pleasure tend to dominate emotional reasons.

- Strength: A relative term to denote greater or lesser significance/importance
- Sequence: Where 2 or more relationships have been applied, the order in which they are to be used.
- Direction: In the sequential processing/use of concepts, some are precedent and some are antecedent.
- Duration: When a relationship is applied and the duration of the relationship.
- Polarity:
    - A relationship is said to be positive if component concepts promote each other, mutually benefit from being together, or provide control/advantage when applied in the real world.
    - A relationship is said to be neutral if there no great importance.
    - A relationship is said to be negative if one or several component concepts suffer, decrease in importance or cause loss of control/advantage in the real world.

Relationships between bits, data, information, knowledge and wisdom are therefore the “glue” that binds concepts together in the UTK. Other analogies exist with the physical world which interested readers might wish to explore:

Unstable arrangements of atoms and molecules.
- Equate to “Unstable arrangements of data and information”
- Concepts with missing data and information don’t retain their original “form”[17]
- Concepts losing extraneous relationships

Cooling
- Disuse of concepts.

Heating
- Increase in the frequency of use.

Effects of Electromagnetic fields
- Concepts with many components tend to interact to a greater extent than concepts with small numbers of components.
- Small concepts cluster around large concepts
- Alignment by relationships through consistent retrieval order/sequences

Effects of gravitation
- Brains acting as attractors of bits, data, information, knowledge and wisdom.

Influx or efflux of electrons
- Flow-in and flow-out of bits.
- Maintaining, constructing or deconstructing relationships with new or old bits

Influx or efflux of particles,
- Flow-in and flow-out of data, information, wisdom etc.
- Maintaining, constructing or deconstructing relationships

Grinding, tearing, pressing etc.

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[17] A generic term, not intended as a physical or morphological descriptor. Read as “form determined by the types of relationships between the components (data and information), the proportions of components and the counts of relationships.

- Intellectual review, self-analysis, questioning, experimenting, challenging etc.
- Change to, and merging of, mutually exclusive concepts.

Points on Memory

The UTK recognizes the crucial role of memory in preserving knowledge over periods of time. It is regarded as an essential part of intellect[18] with direct relationships between intellectual ability and the complexity of memory, its accuracy, precision and detail.

Brains devote populations of neurons to the tasks of storing codified and structured signals to represent bits, objects and processes. These are re-used according to need. Intellects also use the external world as “memory aids” and “supplemental memory”. This range is huge: From the simple scent markings used by insects to the sophisticated libraries used by humans.

It’s convenient to use the generic term “record” to denote a singular memory, regardless of the form it takes. The UTK regards memory as coded physical representation of one or more sensory (or process) Bits. Nature commonly uses synaptic change and biochemical change in memory mechanisms - cells that are responsible for “retrieving memories” actually re-synthesize the Bits responsible for the original memory.

There are 3 forms of memory:

Form 1: As memory

Biological memory involves physical and biochemical change to specialized cells. When these cells are later stimulated they produce signals that represent bits, objects and processes. If the signals are faithful to the mechanisms that created the original memory, then the memory is said to be accurate.

Non-Biological memory is similar to biological memory. There are 2 types: Analog and Digital.

- Analog memory is a controlled change to substances and materials that can be reversed to reproduce the original signal/data/information. Music on a cassette tape is example.

- Digital memory comprises electronically encoded signals (usually as sets of ones and zeroes) that decode to reproduce the original signal/data/information.

Form 2: As a measurement or description or documented activity

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[18] Creatures with low levels of intellect and brains that operate without memory can have ephemeral knowledge accorded by the states of neurons and signals being processed.

Records are products of measurement and description. Usually a record is verbal or involves written numbers or symbols. Records of this type have a durable nature and form the basis of social knowledge.

Form 3: As reproduction or facsimile

A reproduction or facsimile is usually a pictorial copy or representation of an object or scene. Records of this type have a durable nature and are part of social knowledge.

Reproductions/facsimiles also include other physical objects such as sound recordings, motion pictures and other objects associated the UTK conceptual levels. Reproductions/facsimiles can also be recorded as instructions for the duplication of an object. For example a “midi” file is used by electronic keyboards to reproduce a piece of music.

Points on contemporary computer databases

Modern computer database systems through architecture, and design, tend to simple “hard-coded”,” full-strength”, “permanent duration” and “fixed polarity” relationships. This limits their operational ability to working with data, and structured data (information). In UTK terms, this places database systems at the reactionary and instinctual levels of intellect.

Currently there are few, if any commercial reasons for further conceptual complexity in database systems, and several important reasons persist to keep them simple:

- The ongoing need for auditability and accountability is truly challenged if computer systems are able to construct, assign and manage their own relationships without human involvement;
- Most organizations are conservative in respect to technology and few would invest in databases whose data structures are not understood by their technical staff, and
- There are profound cultural problems for organizations if operators and users cannot understand the rules and relationships of the database systems they use.

Repositories of relationships, and mechanisms that create new relationships with variable data structures (for strength, sequence, direction, duration and polarity) are likely to appear in new technology (such as computer games and robotics). These areas have a need to emulate animal and human behavior with flexibility that goes beyond the limits of hard-coded instructions.

Chapter 2: The Bit

("Structured and codified signals")

The use of "Bit" in the UTK is different to that used in computer systems where a bit represents a sole binary state[19]. In the UTK a "Bit" is defined as a *solitary measurement, attribute, property or descriptor deriving from the structured and codified products of sensory (and other) signals*.

When sensory cells produce output signals (usually bioelectrical) with some form or structure and codified representation of the original stimulus, they are said to produce conceptual "Bits". "Bits" are the building-blocks of concepts that appear in intellect operating at the Data, Information, Knowledge and Wisdom levels. Sets of bits become "Conceptual Objects", and when one or more "Objects" interact with each other the result is a "Conceptual Process". "Bits", "Objects" and "Processes" (and combinations of these) are the basis for all known concepts.

"Bits" alone can convey simple concepts which represent aspects of the mechanisms that produce them. The concept of redness for example is a particular set of structured and codified sensory signals from the eyes that relate to sensing light in red frequencies. The concept of a "dog" is more complex and it is an "Object" comprising many sets of structured and codified sensory signals. The concept of ageing is a "Process" that involves objects changing over time.

In the biological context, sensory cells in organs such as the eyes detect external stimuli (light) and produce signals that represent the original stimuli. The signals are typically solitary and/ or periodic "pulses" – simple forms of structure and codification - and they are referred to as Bits. In "downstream" processes there is opportunity for further structuring and codification[20] giving additional Bits for the brain to process. The UTK identifies:

- Sensory Bits produced by specialized sensory cells:
    - Visual/photic
    - Tactile
    - Pressure
    - Auditory
    - Electrical
    - Magnetic
    - Gravitational (sense of balance)
    - Chemical (taste and smell)

- Process Bits produced by "downstream"/internal processes:
    - Regulatory
    - Periodic

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[19] Computer bits denote "off" or "on". Codified sequences of computer bits constitute computer memory.

[20] Shape and edge detection, synthesis of signals for colours other than what the pigments in the photoreceptors are sensitive to, etc.

    - Links to other Bits, and sets of Bits
    - Links between brain regions

- Memory Bits produced by sets of cells that serve to store and reproduce sensory and process bits

- Output Bits produced by processes that are “downstream” from sensory cells for the purpose of controlling muscles, organs and glands.

Bits can also be likened to the elementary particles of the universe that combine in various ways to produce atoms. This analogy is useful, because there are small numbers of particle types and bit types, and both conform to rules of behavior and interaction.

In general, intellect uses bits to:

- Create concepts of objects, processes and systems
- Monitor external and internal stimuli
- Expand, refine and improve concepts
- Reduce ambiguity, improve accuracy and precision;
- Emphasise particular parts of concepts
- Indicate the relative importance of components of concepts
- Qualify a process or activity
- Denote quantity.

It is also useful to liken Bits to the common pronouns, numbers and adjectives used in English that describe the properties of objects and processes. Isolated descriptors such as the word “red” represent simple concepts by themselves and complex concepts when joined with nouns and verbs. Nouns and verbs derive from bits structured into objects and processes respectively.

Chapter 3: Data

("Measurements")

The components of data are Bits. The UTK defines data as *sets (or groups) of Bits that have one or more things in common*. Processes of intellect impose structure and relationships with bits and concepts are formed.

Intellect that operates at the "data-level" of conceptual complexity is said to be "Reactionary" and creatures with such intellect show simple, stimulus-driven (action-reaction) behavior. Usually there are several neuron-mediated steps between action and reaction

Most readers are aware that the term Data is used as both a singular and plural noun. A single item of data is also called a datum[21]. The sources of data are dominated by sensory input but Data can also come from specialized neurons in a brain. An example is the so-called "biological clock" which triggers various physiological processes through days and nights and months. In another example there are populations of monitoring neurons, contributing to the various aspects of self awareness (- the sense of the passage of time, sense of being well or unwell etc.). Populations of neurons can also produce data after deductive and inductive processes, including learned algorithms.

Data can take the form of measurement, descriptive narrative or facsimile. A broad definition is useful so that both ephemeral and longer-lasting forms are covered: The needle location on the dial of a gauge can be data, as can be rows of figures in a spreadsheet, a sound and a photograph.

Data usually indicates:

- Status
- State
- Value
- Physical dimension
- Intensity
- Duration
- Orientation

Data is said to have a value range from "false" to "accurate". The word "false" is used in the sense of having no relationship to a specified object, process or system. The word "accurate" is used in the sense of being acceptable for an intended use. Between these, data can be more, or less, accurate.

Value Range	**Example:** **(The measured width of an apple)**
False	100 kilometers
Accurate	5 centimetres

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[21] It helps to think of a datum as a number in a cell of a spreadsheet

With measurements, statisticians refer to the margin of error of the measurement process. An apple might be measured as 5 cm +/- 0.1cm using the lines of a plastic ruler, but using a micrometer gauge it might be 4.982 cm +/- 0.001 cm. For the purposes of the UTK, the measurement made by the micrometer is regarded as being more accurate than that made with the ruler. This value range applies to all sources of data from the physical world.

Sensory input can become “confused” however and give incorrect “False” results (optical illusions are good examples). Populations of neurons within a brain can also output false results, and cause data-level problems such as“phantom limbs” which some amputees’ experience.

The accuracy of sensory input also varies: The tactile feedback from the fingertips is quite different from that which comes from the skin of the elbow, yet both provide useful data.

Data can be made from other data: Calculations can be performed on measured data and the results can be data. Usually this occurs when the method of calculation yields a result that is the same as if a measurement actually took place. For example the diameter and height measurements of tin cans can be used to calculate the volume of the tin cans instead of individually measuring their volume.

The various forms of data are:

- Structured bits
- Bits associated with concepts of objects. E.g. “red apple”, “10 red apples”
- Bits associated with concepts of processes. E.g. “red explosion”
- Bits associated with concepts of systems. E.g. “red solar system”
- Bits associated with concepts of data. E.g. “10 data attributes”

The last bullet point above is a particular reference to “data about data”, which is also called metadata. This term usually refers to summaries of properties or attributes of data such as type, ranges and duration. For example, an unstructured set of dates typed on a piece of paper has metadata comprising date range, date format, the color of text, font type and font size.

For purposeful use by intellect, data needs to be explicit and of clear, unambiguous meaning. There will always be contextual relationships, aspects, properties and limits associated with data, but these constitute the “working assumptions”, “givens” and “non-critical aspects”. For example a child might be measured as 1.5 metres tall. This measurement has contextual data (which may not be recorded, but inferred or implied at the time) that relates to the age of the child, the date of measurement, the methods and tools of measurement.

When intellect is limited to working with data in real-time situations, the result is simple stimulus-driven behavior. This is the lowest level of intellect observed in creatures with nervous systems and such creatures are said to possess “reactionary” systems (examples being jellyfish and earthworms).

Do Plants and Protozoa Have Intellect?

Nervous systems are not a mandatory requirement for intellect in the UTK. Any plant or creature with specialized cells, or mechanisms, that effect multi-step changes to other parts of their body can be said to have "rudimentary" intellect operating at the reactionary level.

Human Technology with Intellect

A lot of human technology is advanced enough to qualify as reactionary intellect[22]. Examples are found in "systems" that utilize sensors for reactionary-style mechanisms, such as automated refineries, transport systems and modern railways.

Examples can also be found in computer systems dedicated to modeling, forecasting, gaming and real-time systems. Some of the sophisticated computer viruses can also be regarded as possessing rudimentary intellect.

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[22] Not to be confused with the terms "living" or "life".

Chapter 4: Information

("Collated measurement, concepts, fiction")

Information is formally defined as "*Structured data*" in the UTK. In general, information comprises sets of data representing objects and processes that are related in one or more ways.

The sense of hearing, as an example, starts with families of sensory cells which are sensitive to different frequencies of sound. The outputs of these cells (bits) are combined (data), then associated with other things to become recognized information. Successful processing yields information and unsuccessful processing results in "noise".

A practical way of classifying something as information is to test if a table can be produced[23]. Modern office processes for example, produce information by placing tabular data into spreadsheets to manage financial figures, measurements and observations. Tables visually arrange data to depict relationships between the column headings and the rows (- column headings are usually measurement intervals, such as months of the year, and rows are usually references to objects or processes).

In more-abstract form, Information is the product of joined concepts via data they have in common. The sentence

"John and Paul both arrived at work at 10:00am"

contains concepts linked by data and is therefore classifiable as information. "John", "Paul" and "work" are object concepts and arrival is a process concept qualified with time data[24]. Each concept has underlying data specific to itself and the example readily converts into a table of information:

Employee	Work Arrival Time
John	10:00am
Paul	10:00am

If the sentence is modified to "John and Paul arrived together at work at 10:00am", the scope of the information extends to cover the concepts of independent arrival and arrival together:

Employee	Work Arrival Together	Work Arrival Time
John	Yes	10:00am
Paul	Yes	10:00am

---

[23] Single-column lists are not considered information in the UTK. If a table with 2 or more columns can be constructed, then call it information. Otherwise it's data, knowledge or wisdom.

[24] The "10:00" is a bit made into data by joining it with the time concept of "am". Alternatively. 10:00am can be referred to as a measurement and is therefore data.

A variation of this sentence:

"John arrived at work at 10:00am looking unwell and tired"

Contains 2 object concepts (colored blue), 2 process concepts (yellow) and 3 items of data shared between the objects (green). The sentence readily converts to a table by utilizing generic headings that refer to health and physical appearance. These headings are also referred to as "class names"[25]:

Employee	Work Arrival Time	Health	Physical Appearance
John	At 10:00am	Unwell	Tired

When grouping or structuring data to produce information, explicit and implicit relationships are assigned and inferred. This highlights an important difference between data and information: Information has relationships; data does not, and is the third principle of the UTK:

Principal No 3: Information has relationships, data does not. **Each level of the UTK comprises the structured products of lower levels.**

Explicit relationships are documented relationships made at the time the measurement or description was recorded. Implicit relationships utilize other sets of data (and information) such as class names, physical properties processes, rules, laws etc. to structure the data.

Examples of explicit relationships are

- Row and column headings for data
- Citing particular objects, processes or systems in a description

Implicit relationships can be:
- Secondary, tertiary and other groupings of the main set of data
- Progressions
- Inferences
- Calculations
- Deductions
- Predictions
- Assumptions

In the UTK, Information has a value range from fiction to factual. The word "fiction" is used in the sense of being based on imagined/non-real-world objects (or non-real-world processes) and factual is used in the sense of being based on real-world objects or processes.

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[25] Although constructing tables is an activity that requires knowledge from a human perspective, neurological research indicates that brains have "hard-wired" mechanisms for achieving this.

Value Range	**Example:**
Fiction	Descriptions of mythical creatures
Factual	Descriptions of animals in the zoo

Information about information is called meta-information. This term usually refers to supporting information on the ways data is grouped to form information and the properties of the information. Meta-Information is useful for:

- Monitoring and “administrative” purposes
- Identifying gaps or omissions in information;
- Assessing the suitability of component data;
- Providing insights into properties and details shared by separate items of information, and
- Integrity checking of information, like the checksum bits used in computer files.

Intellect that operates at the information level of conceptual complexity is said to be instinctual. Insects and other creatures with simple brains are examples of this. They have recognizable brains and several types of sensory input which are processed via (relatively inflexible) neural mechanisms. Memory has a minor or nonexistent role, but sensory input can be efficiently processed, filtered and categorized, then lead to instinctual behavior. Instinctual behavior includes:

- Non–learned locomotory skills
- Fear, flight, attack, mating and other reactions
- Anticipation of movement
- Pattern recognition (prey, food plants, potential mates, “home”, etc.)

Social behaviors and simple learning are considered to be features of instinctual intellect, but (seemingly) complex mental processes are usually fixed at birth by genome. Intellect at this level also encompasses the traits of lower level “reactionary” intellect, and in most respects logically extends these traits.

Do Plants and Protozoa Have Instinctual Intellect?

Instinctual intellect leverages the abilities of brains to codify and interpret the world. This excludes single-celled animals and plants.

Human Technology with Instinctual Intellect

Desktop computers, minicomputers and mainframes operate at the instinctual level of intellect. Most computer systems are “hard-coded” in the sense they are pre-designed to take data (from various sources) then do certain things through association, calculation and manipulation.

Chapter 5: Knowledge

("How things were and how things are done" or "It's not the data and information that's important, but what's done with them")

Early in this document the term knowledge was given two definitions. In the first it is a general reference to the products of a functioning brain and the second definition has knowledge as the product of structured information (sets of information that have one or more relationships assigned by intellect). This chapter is devoted to the second definition.

In the UTK, knowledge is placed as a conceptual level above information and below the level of wisdom. Following the approach used with lower levels, knowledge is defined as structured information. Applied knowledge is also referred to as intelligence.

What is meant by structured information? Whereas information is table-like representation of data, the UTK assumes a multiplying effect and portrays knowledge as many sets of related tables. Table relationships are managed by processes that provide structure. This is illustrated in simplified form in diagram 3.

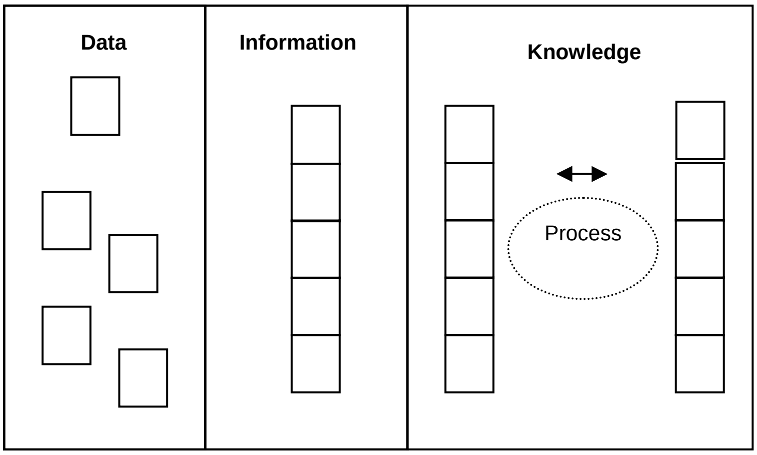

Diagram 3: Information and knowledge as successive structuring of data

Note that diagram 3 depicts a simple one-to-one link for items of information. Readers should be mindful that one-to-many and many-to-many relationships also exist, as well as cross-linking between items of information. An item of Knowledge can also be defined by its set of component data, information and processes.

In contrast to lower levels, intellects operating at the level of intelligence possess faculties for the construction and self-modification of mental processes. Commonly referred to as learning, this is in addition to fixed, genome dependent abilities of intellects operating at the instinctual level, and obviously empowers creatures with greater adaptability and versatility. Intelligence is also able to expand nature-endowed set of "hard-wired" relationships with new relationships formulated during the life of a creature. Memory plays a key role in these processes. Other attributes of intelligence include variable social organizations, communication, tool use and altruism[26].

Items of knowledge usually have time-based attributes and an emphasis on how things are done, outcomes or values. Most have a well-defined starting point for an item of knowledge and a well-defined end point that cover a span of time.

Memory provides reference points for intellect: How things were, and how things are done. Related to this is the concept of experience – an instance of an activity, and its repetitions, being remembered and compared to current situations. Accurate memory is thought to provide greater survival advantage.

The brains of intelligent creatures range in their ability to create knowledge and to remember knowledge. It's also appropriate to refer to this knowledge in relative terms such as simple and complex. When the quantities of information and the processes are large, knowledge can take the form of dynamic simulations that can be varied by intellect to anticipate outcomes.

Knowledge also extends the relationships between objects, and processes, to include importance. Importance covers such things as emotional satisfaction, personal value, social benefit, efficiency, effectiveness, economy, risk and viability.

It is assumed that the brains of intelligent creatures utilize economical mechanisms to produce and manage knowledge. One idea is that animal brains utilize general purpose templates ("reusable blank tables") for temporary storage of information, and sets of "template" processes that operate using sets of generic relationships[27] like so:

> *Raw sensory inputs are filtered, collated and processed into information for temporary storage in single or multi-column "tables"[28]. Adding additional processes to relate "tables" either to themselves or to other tables produces knowledge. Processes can occur concurrently, such as filling multiple tables at the same time, and this gives useful speed boosts.*

Evolution has favored concurrency and produced "massively parallel" brain architectures such as those seen in mammalian brains, for the likely reason that this confers survival and reproductive advantage. Most intelligent creatures have abilities to learn, and these abilities are assumed to derive from trainable neural circuits that create "new" processes from existing processes and new sequences of processes.

When intellect structures data into information, then structures the information into knowledge, conceptual complexity is increased. The intellectual processes are very important and the application of knowledge is called intelligence. There's also room for specialization and unique applications of intelligence. Common pets such as birds, goldfish, cats and dogs illustrate both specialization and variety in intelligences. In general terms however most intelligent creatures share the following common abilities to a greater or lesser extent:

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[26] Readers are reminded at this point that the UTK places humans in the next level (sapience) because humans possess both intelligence and wisdom. The text above is intentionally generalised so that there is good coverage of the range of intelligences found in the animal kingdom.
[27] Also referred to as "array processing" with standardised processes
[28] Single, two and multi-dimensional tables are assumed.

- Remembering series of actions
- Problem solving
- Puzzle solving
- Reasoning
- Anticipation
- Self-awareness (limited), and awareness of others
- Knowing that objects continue to exist when not immediately sensed
- Social ability
- Communication
- Following instructions[29]
- Language
- Tool use
- Concepts of events and processes
- Ability to classify
- Applying principles, ‘Rules of thumb’ etc.

Readers are reminded that humans show intelligent, as well as reactionary and instinctual, behavior. Human intellect also operates in the next level of the UTK which addresses wisdom and its application (sapience).

The mix of component data, information, processes and relationships causes knowledge to vary in “quality and usefulness”. The UTK addresses this variability by referring to knowledge as having a value range that extends from Uncertainty to Certainty. The word “Uncertainty” applies to knowledge formulated with gaps and omissions and which has poorly customized/integrated processes. Certainty is somewhat subjective, but is applied to knowledge that has no (apparent) gaps or omissions and has highly customized/integrated processes and relationships. Accordingly, intellects are said to utilize knowledge with greater and lesser degrees of certainty. The table below provides several examples:

Value Range	**Examples:**
Uncertainty (“speculation”, “conjecture”)	• I’ve seen something but I don’t understand what I’ve seen. • I can’t anticipate the outcome. • I can’t relate these pieces of information together.
Certainty	• I hold my red ball in my hand • I am hungry. • Something is coming towards me.

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[29] From doing what the “pack leader” wants to more civilised activities such as following cooking recipes, using manuals, and making or assembling things.

Knowledge about knowledge is called meta-knowledge. Meta-knowledge is not a term in common use, but conceptually it's the scope and properties of items of knowledge. It comprises lists of component data, and information, details on associated processes and the relationships between these items. Meta-knowledge is useful for:

- Monitoring and "administrative" purposes
- Identifying gaps or omissions in knowledge;
- Assessing the suitability of component information;
- Providing insights into properties and details shared by separate items of knowledge, and
- Integrity checking of knowledge, like the checksum bits used in computer files.

The relative terms used in common conversation of "low intelligence" and "high intelligence" are useful to indicate where a creature's intellect sits in this level of the UTK[30]. The term "expert knowledge" is also useful to denote knowledge that is:

- Acquired by with creatures with intellect operating at the upper end of the intelligence scale
- Specialized
- Formulated from a lot of experience
- At the "certainty" end of knowledge's value range.

[Another common term, "Genius" is used in the next level of the UTK].

Concept Ecosystems

It's at the "Knowledge" level in the UTK that the idea of "concept Ecosystems" has merit. A Concept Ecosystem is one or more concepts, assembled by intellect, that interact according to rules/properties that the intellect applies. Concept Ecosystems can be regarded as mental processes that simulate (or model) aspects of real-life. Like a computer simulation, the components are primed with starting information and then allowed to interact for a period of time. During this time additional data and information might be included and the states of the interacting components are monitored. This approach is useful for problem-solving activities and the system might be reset and re-run many times to achieve a satisfactory result. Whether the rules of interaction are consciously managed or not[31], concepts interact in various dynamic ways and outcomes are not known in advance[32]. Successful Ecosystems can be remembered as "snapshots" and subsequently re-created.

Simple Concept Ecosystems have roles in providing survival advantage for creatures with the intellect able to use them. In the example of a predator tracking down a prey animal, simple Concept Ecosystems in the predator's brain are created to anticipate the behavior of the prey. Initially it may be a mix of trial and error, but the successful Ecosystems (successful hunting outcomes) will be favored. The predator's brain can "snapshot" the starting patterns of the populations of neurons as a "memory" for future re-use.

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[30] A cat can be an expert at catching mice.

[31] It is hypothesised that (some) instincts are gene-encoded concept ecosystems– pre-defined starting patterns, and rules, to simulate and anticipate real-world situations.

[32] It is assumed that intellect can optionally set end-state conditions for concept ecosystems, and then re-run with changes to determine which set of information, processes and relationships best approximates the desired end state.

Concept Ecosystems, unlike memes and meme complexes, do not have a requirement to reproduce or propagate but there are otherwise many similarities. Key properties of "concept Ecosystems are:

- Ecosystems have a starting point ("point of initialization"), and a period in which the component concepts are allowed to interact with each other. Some Ecosystems have end points (often when a goal is achieved) and others continue indefinitely, but are subject to periods of time in which they are kept in a paused state
- Ecosystems can receive inputs while components interact[33]
- Ecosystems can drive behavior, or provide behavioral choices
- Intellects derive value from Concept Ecosystems through being able to change and re-run, monitoring or progress and outcomes ("final states")
- Where two or more concepts are involved, various forms of concept coexistence emerge (e.g. balanced, competitive, evolutionary, devolutionary)
- Concepts can change as data and information interact
- Concepts can combine to form new concepts
- Use and disuse by intellect ("concept life and death")
- Ecosystems can be subject to selection pressure, promoting themselves and other
- Favoring by intellect of Ecosystems that have tangible value, reproductive advantage, social advantage or personal pleasure.

The UTK assumes that Concept Ecosystems increase in complexity as the component concepts increase in complexity. At the level of intelligence, concept ecosystems are regarded as simple simulations that can achieve information-equivalent complexity. This is to say that an intelligent creature like a dog can simulate insect (equivalent) intellects/behaviors in its brain. With levels beyond intelligence, the Concept Ecosystems become more complicated, and more sophisticated, simulating more aspects of the world.

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[33] Inputs can be direct feeds from sense organs, memories and feeds from other concept ecosystems.

Chapter 6: Wisdom

("Some things are better than others, for lots of reasons")

Following the approach used with lower levels, Wisdom is defined as *structured knowledge*. Human intellect is placed in this level, and some primate species are candidates for the lower-end of the range.

In chapter 1, it was postulated that brain, intellect and knowledge have fixed relationships on an exponential curve that ranges from zero to infinity. The step from intelligence to wisdom illustrates this with the huge gaps that exist between humans and other animals.

Wisdom relies on remembered bits, data, information and knowledge and includes abilities to manipulate each of these. This is a logical extension of the processes of knowledge: Knowledge links information and wisdom links knowledge. Wisdom derives abstract relationships and assigns relative importance from "cause and effect" situations, experience, anticipation and circumstance. Self-awareness – the total effect of many processes that monitor other processes - is also regarded as a standard feature of this level, with the term "consciousness" denoting human levels of self-awareness.

One interesting feature of wisdom is the ability to formulate sophisticated judgments on the outcomes of processes that have not yet completed. The judgments might be based on numerous items of knowledge that don't have a direct relationship to the topic. For example:

> *Applied knowledge (intelligence) is used to score written applications and select a group of people to be interviewed for employment. Wisdom is used to judge and select the successful candidate.*

Language, which appears in intellects operating at the level of intelligence, becomes more complicated, and varied at the level of wisdom. This logical enhancement of the processes/abilities of intelligence is regarded as a "given". Where intelligence is (mostly) limited to anticipation of events and outcomes of processes, with wisdom the components of small systems are understood to the extent that advice and judgment can be made on them with confidence. There is sophisticated anticipation of events and outcomes, plus understanding of what is required to effectively intervene to achieve a desired outcome. Small systems can be:

- The sum of behaviors, motivations, desires etc., of individual human beings
- Groups of people, such as families and villages
- Individual and group behaviors of lesser creatures
- Natural phenomena such as small ecosystems and local weather

The scope of wisdom is limited to things that occur in small systems, but it touches upon the outcomes and anticipation of interacting systems (- this ability is further developed in higher levels).

Conversely, the same processes that provide anticipation of events can be "run in reverse" to provide detail on, and insights into, past events. This aids learning processes, as well as helping other processes (such as assumption testing and "what-if" scenarios).

What is meant by structured knowledge? In the previous chapter, knowledge was portrayed as sets of tables (of information) linked by processes. Wisdom extends this complexity by being the product of many sets of cross-linked knowledge. There is an underlying presumption that the cross-linking processes in wisdom are variants of the linking processes in knowledge. Wisdom is also assumed to flexibly utilize data, information and knowledge through dynamic linking mechanism (similar to the "link tables" used in modern databases that map important fields in one table to fields of another). This mechanism is thought to be the basis of abstraction and is illustrated (in simplified form) in diagram 4.

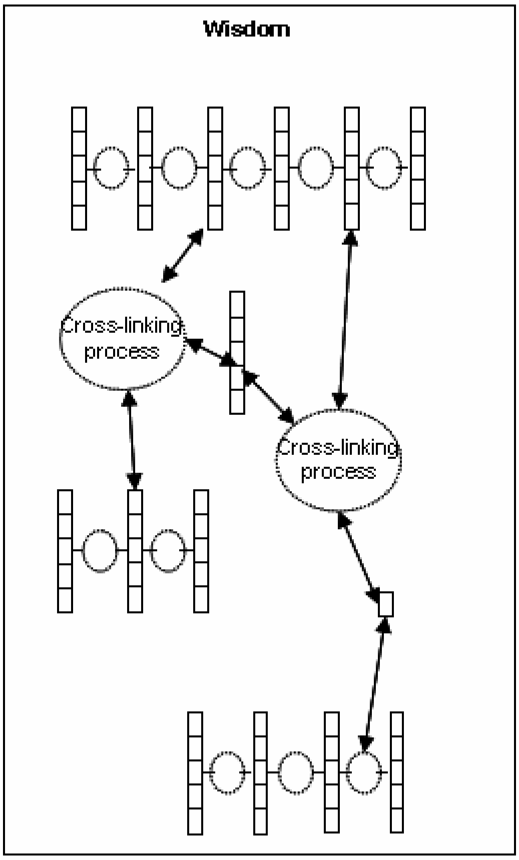

Diagram 4: Wisdom as cross-linked knowledge

Wisdom has a value range in the UTK from Non-Truth ("fictional") to Truth. The word "Non-Truth" is used in the sense of being false in every aspect of narration, detail and description, and Truth is used in the sense of being correct in every aspect of narration, detail and description.

Value Range	**Examples:**
Non – Truth ("lie", "falsehood")	All people are stupid.
Truth	All children benefit from good nurture

Truth is the end point of the value range of Wisdom, but to be consistent with the lower conceptual levels, truth must be based on high-certainty knowledge of factual information using accurate data. Between non-truth and truth there is "belief". For the purposes of the UTK, whenever underlying data, information and knowledge is not wholly accurate, complete, factual and certain then the word belief applies ("I believe that …").

Whereas most people can agree on the relative certainty or uncertainty of any item of knowledge, the complexity of wisdom results in opinions on Truth. Truth also appears to undergo simplification as it is communicated from individuals to (small) groups to societies and finally to all of humanity. Like democracy, the conceptual components for any "truth" vary, but require a majority endorsement when shared by groups, societies and humanity. So to accommodate this in the UTK, the value range of wisdom has the implied qualifiers of "Regarded personally or socially as a non-truth" and "regarded personally or socially as a truth".

As mentioned earlier, wisdom is the level of conceptual complexity that sits above knowledge. When wisdom is applied by intellect, the result is sapience. Sapient behavior includes:

- Morals
- Ethics
- Laws
- Written language
- Anticipation of outcomes of processes and (small systems)
- Strategic planning
- Complex social interactions
- Qualitative assessment and interpretation.
- Fuzzy logic

How far and how well can sapience anticipate the outcomes of interactions between objects, processes and systems? The UTK regards this as a limited ability of sapience, but enhanced through the use of tools[34]: Sapient creatures can identify the value and likelihood of one or more outcomes, plus estimate the time periods involved, but the uncertainty associated with anticipated events tends to be high. "Betting on the horses", a favorite human pastime, is a practical example.

Within human populations, some people are "more wise" than others[35]. Wise people are generally those who can judge and provide useful advice on social issues, or for social benefit. The traditional village "wise man" is an example of this. "Specialized wise" individuals can also be found in all areas of human endeavor – from the sciences to the arts, commerce, travel and exploration. Similar to the term "wise", the term "learned" also has popular use. A "learned" individual has many years of education and association with institutions of learning.

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[34] Tools range from simple memory aids, such as written notes and drawings, mechanical devices such as clocks and computer systems.

[35] . This term is often incorrectly used as a reference to intelligence rather than wisdom.

The term "genius" is also useful as a descriptor for the upper end of sapience. At the lower end of the sapience scale the terms "moron" and "idiot" are sometimes used for humans, but a general-purpose term such as "child-like" is more useful because it has fewer derogatory connotations.

"Wisdom about wisdom" is referred to as meta-wisdom in the UTK. This is not a term in common use, but conceptually it's the scope and properties of items of wisdom. It comprises lists of component data, information and knowledge, details on associated processes and the relationships between these items. Meta-wisdom is useful for:

- Monitoring and "administrative" purposes
- Identifying gaps or omissions in wisdom
- Assessing the suitability of component knowledge
- Providing insights into properties and details shared by separate items of wisdom
- Integrity checking, like the checksum bits used in computer files.

Some authors believe that Meta wisdom is the basis for "self-awareness" (consciousness) and learning; however the UTK assumes that self-awareness derives from abstracted information via processes that first appear at the level of intelligence. Quantity and complexity of such processes, and therefore "self-awareness", are assumed to increase as intellectual ability increases.

Concept Ecosystems at the wisdom level

Concept Ecosystems at the wisdom level are more complex than those created at the knowledge level. Complexity in this context refers to having more processes, more data, information and sets of structured information (knowledge). With large numbers of concurrent processes, imaginary scenes, dialogs and experiences seem to "have a life of their own".

Human intellect is sufficiently complex, with enough mental processes, that it can operate animal-equivalent Concept Ecosystems that simulate the behavior of animals, or simple simulations of people. This ability makes humans successful herders and hunters. An "urban" variation of this is the example of dog and cat owners "knowing" their pets so well that they can comprehensively anticipate moods, reactions and other behaviors.

Using the external world to extend intellect

Creatures with intellect operating at the level of intelligence display limited use of the external world to assist and extend their intellectual processes. At the level of wisdom however, this is regarded as a basic skill. Sapient intellect uses a variety of mechanisms and tools to assist and extend itself in three areas. These comprise external memory, external processes and sensory aids:

- External Memory:
    - Using others to remember things.
    - Written records, pictures and recordings.

- External Processes
    - Using others to solve problems, investigate issues, summarize etc.
    - Creating models and simulacra.
    - Programming, using computers.

- Sensory aids
    - Devices to record.
    - Devices to magnify.
    - Devices to amplify.
    - Devices to detect temperature, surface features, internal features.
    - Devices to communicate with.

Although for humans these “aids and extensions” have minor roles in mental processes, it is presumed that externalization is factor that increases for intellects that operate at higher levels. This de-homogenization and de-centralization of brain and intellect raises some interesting issues which are discussed in the next chapter.

Chapter 7: Transcendent Wisdom

("Being excellent in all things and having precognition")

Following the approach used with lower levels, Transcendent Wisdom is defined as structured wisdom. The term "Transcendent" has been taken from philosophical and religious literature where it variously means "excellent in all things", "beyond human intelligence" and "spiritually advanced". In this document however "Transcendent Wisdom" is used without magical or religious connotations.

This level is not experienced by human intellect, but it has properties that extrapolate from those of wisdom[36]. Readers should be mindful of the (postulated) exponential curve for brain, intellect and knowledge, so Transcendent Wisdom is not an incremental enhancement of wisdom - it is several times greater. A helpful analogy for comparing Transcendent Wisdom to Wisdom is to compare a university professor to a pre-school child.

Compared to human intellect, a creature with intellect operating at the Transcendent level would appear to be "wise in all things" and:

- Have greater memory;
- Have more concurrent processes in its brain;
- Cope with matters of great complexity, and
- Have greater externalization of memory and intellectual processes.

Whereas wisdom uses concepts that are complex enough to provide "understanding" of part-systems and small systems, Transcendent Wisdom's abilities are presumed to extend to large systems[37]. A ramification of this is an ability to anticipate, with accuracy, the outcomes of interactions between objects and processes. This ability is otherwise known as precognition. Conversely, the same processes that provide precognition could be "run in reverse" to provide detail and insights into past events. In contrast to sapience, the re-creation of past events by a Transcendent intellect would be extremely realistic.

Humans influence, change and judge their environments in many different ways. Transcendent wisdom is expected to extend these abilities, with greater precision and accuracy. The values and principles behind any "judgment" made by a Transcendent creature would go beyond human wisdom and embrace broader concepts such as what is "best" for entire systems[38].

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[36] The author has the opinion that advances in medicine and technology is likely to enhance human intellect to transcendent levels in the next 100 years.

[37] This is in the sense of having a minute understanding of all of the components of any large system and how these components interact to produce the behavior and outcomes of the system

[38] This has interesting ramifications for human morals, ethics, morals and laws and, if contemporary "futurologists" are correct, may become significant issues for society later this century.

In the UTK, Transcendent Wisdom is said to operate within a value range that starts with non-anticipation and extends to precognition. To distinguish this value range from those of higher levels, it is phrased in the context of “within systems”.

Value Range	**Examples:**
Non-anticipation	An event or outcome is not anticipated
Precognition	Events and outcomes are anticipated

Non-anticipation occurs when no effort is made to anticipate an event or when components of an attempt have value ranges approaching non-truth, uncertainty, fictionality and inaccuracy. Anticipation increases as these components move to the other ends of their respective ranges. With precognition, events and outcomes are accurately and precisely anticipated.

Applied Transcendent wisdom is referred to as Transcendent behavior. A hypothetical creature born with an intellect capable of operating at the level of transcendence would develop a very large memory comprising data, information, knowledge and wisdom, plus a range of “supra-human” mental functions for managing these. The recursive grouping and abstraction described in earlier chapters for information, knowledge and wisdom is assumed to continue with Transcendent wisdom, giving rise to “super-structures” of wisdom.

What sort of behavior could be expected of a Transcendent creature? Although this is an area of speculation, it is surmised that basic behaviors would persist, driven by such things as hunger, thirst, excretion, desire for social interaction, mental stimulation, desire for comfort and security. Behaviors outside of these would probably be unintelligible to humans.

Nature’s approach of locating sensory organs close to brains gives quick reflexes and obvious survival benefits, but this also limits the senses to the immediate environment around a creature. This is a physical limitation that intellect copes with, but it can be considered as a limiter of conceptual abilities. The UTK presumes that Transcendent intellect features a decentralization of senses and (some) decentralization of brain functions. For humans the combined effect of enhancing brain functions with technology and medicine and augmenting brains to utilize remote and synthetic sensory input (in the sense of an extended, virtual body), may mark the appearance of Transcendent intellect in human society. The simple “artificial eye” and “artificial ears under development are obvious precursors to sensory technology that could literally span the world. It’s also likely that future versions of this technology will go beyond artificial sensory organs to tele-operated tools and specialized extenders of mental function. Popular science fiction portrays these as “implants” that may do things like advanced mathematical calculations, translating languages, provide information and other tasks.

Advances in medicine and technology, artificial intelligence and meme-based intellects suggest five routes to transcendence:

- Augmented/ enhanced humans with implanted technology and links to externalized processing, memory and senses;

- Copies of human intellect “uploaded” into computer systems and then enhanced in various ways;

- Artificial intelligence (AI): Some AI systems have gone past instinctual levels of operation into the lower levels of intelligence. Efforts to produce technology that mimic complicated functions of brain might create human-equivalent and then transcendent intelligence sometime this century.

- Transcendent meme intellects: Chapter 11 considers the possibility that a large and “close-knit” human society has the potential to sustain meme systems that are complex enough to deserve to be called intellects.

- Hybrid Transcendent “systems” with human, AI and meme components.

Author Ray Kurzweil in his book in “The Singularity Is Near”, wrote at great length on trends that point to a transcendence of human intellect this century, combining several of the points above. This book is strongly recommended to interested readers.

Organic brain structures are the significant components of intellect operating at the sapient level, but technological development might one day result in inorganic components dominating intellectual processes. Regardless of whether Transcendent intellect has organic or inorganic origins a 4th principle of the UTK emerges:

> ***Principal No 4: Processes for brains, intellect and knowledge do not require an organic basis of operation.***

Would a Transcendent intellect bother to deal and interact with humans? The answer to this is yes, for two reasons: Transcendent creatures would have their own limitations, and transcendence does not imply access to infinite resources. In the hypothetical scenario where humans and Transcendent creatures co-exist, interactions would occur along several lines:

- Trade: Exchange and supply of energy, raw materials, manufactured goods, software, knowledge etc.

- Services: The provision or commission of services, projects, constructions and suchlike.

- Charity: Humans provide charity to those affected by disaster and unfortunate circumstance, including animals. Transcendent intellect would probably do the same.

- Harm and risk management: Humankind and Transcendent creatures taking precautions to minimize risks and harm from accidental and malicious situations.

- Law: Formalized rules, activities and interactions, with socially condoned outcomes are essential for the smooth operation of society, regardless of the intellectual ability of its members.

- Memes and meme complexes: Both humans and Transcendent creatures would be affected by memes. A Transcendent intellect would probably create, use and manage memes in its dealings with humans.

Concept Ecosystems at the Transcendent level

Concept Ecosystems at the Transcendent level would be more complex than those created at the sapient level. Complexity in this context refers to having more processes, more data, information, knowledge, and sets of structured wisdom.

It is speculated that (with lots of memory and concurrent processes) a Transcendent intellect could create conceptual Ecosystems complex enough to be called "human equivalent" and it's not unreasonable to assume that a Transcendent intellect would be able to simulate the complete intellects of one or more humans within its own mind[39]. Larger quantities of lesser intellects would also be possible. A Transcendent intellect, like lower-level intellects, would utilize such concept Ecosystems to simulate, anticipate and explore scenarios, and then apply the results to real-world situations

From a practical viewpoint, a Transcendent intellect might utilize human-equivalent Concept Ecosystems for tasks such as trade, manufacturing, transport, monitoring systems and exploration. In dealings with humans, these systems could operate as semi-autonomous agents, perhaps appearing as simulated human beings on television, telephone, internet and printed media.

Using the external world to extend Transcendent Intellect

The UTK presumes that Transcendent intellect continues the trend of using of the external world to assist and extend itself. Whilst decentralization of intellect is likely at the level of transcendence, it is presumed that external memory, external processes and sensory aids would be key areas of difference with human intellect:

- External Memory:
    - Complete "backups" of personal memories
    - Using external concept Ecosystems to form and store memories.
    - Permanent, multi-dimensional records, pictures and recordings.

- External Processes:
    - External concept Ecosystems as emissaries/agents.
    - Creating (very complicated) models and simulacra.
    - Using the intellects of lesser creature to run processes
    - Use of memes and meme complexes

- Sensory aids:
    - New/artificial senses
    - Long-distance sensing

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[39] It may be practical to grade intellect at the transcendent wisdom level according to extent and scope of the abilities to simulate human minds. A transcendent intellect able to simulate only one human might be placed at the lower end of the scale and an intellect able to simulate hundreds of humans might be at the upper end of the scale for transcendence.

Chapter 8: Polycendent Wisdom

("Pervasive precognition")

Following the approach used with lower levels, Polycendent Wisdom is defined as *structured Transcendent wisdom*. This level is two levels above the level of wisdom that humanity is placed in, and by coarse analogy the intellect of a creature with polycendent wisdom would compare to humans like human intellect compares to insects.

Readers should keep in mind that a creature with polycendent intellect would still be subject to limitations of physical location, memory, processing ability and other constraints. But these limits might not be obvious, or intelligible, to human intellect and only poorly understood by Transcendent intellects.

The term Polycendent is a composite term intended to describe intellect that is many times more complex than Transcendent intellect. As indicated in the previous chapter, the scope of Transcendent Wisdom is limited to large systems and their components, so Polycendent Wisdom is an expansion of this and covers "multiple large systems". In practice this would involve huge numbers of memories and concurrent processes that give minute understandings of systems and interactions across them[40].

Diverse and geographically distributed sensory input, sophisticated post-processing of sensory data and (very) large numbers of concurrent intellectual processes would be key features of polycendent intellect. Precognition is assumed to be pervasive as a result of these: From sophisticated observation, interpretation, association, deduction, inference and simulation, a hypothetical creature with an intellect operating at polycendent levels would anticipate the outcomes and events in natural, technical, and social systems. Long-term predictions made by a polycendent creature would be very accurate.

Conversely, the same processes that provide pervasive precognition could be "run in reverse" to provide detail and insights into past events. Realistic re-creations of entire systems would be a feature of polycendent wisdom.

The memory, and memory systems, of Polycendent intellect would be supersets of those for Transcendent intellects, and several orders of magnitude greater. By coarse analogy, if normal human memory is a megabyte in size, Transcendent and Polycendent memories would be a gigabyte and terabyte respectively[41].

The value range of polycendent wisdom relates to interacting systems and how well the events and outcomes of these are anticipated:

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[40] The term "conceptualization of mega-systems" can be useful in discussions concerning polycendent wisdom.

[41] The author has read that a life-time of human memories is likely to be measured in petabytes (1 petabyte=1000 terabytes), so transcendent memory might be measured as thousands of petabytes, and polycendent memory might be millions more.

Value Range	**Examples:**
Non-precognition for system(s)	System interactions and outcomes not anticipated
Pervasive Precognition	System interactions and outcomes fully anticipated

The application of polycendent wisdom is polycendent behavior. As with Transcendent intellect, core “needs” would drive some behavior - “needs of the body”, desire for social interaction, desire for comfort and security. Apart from these, the behavior of polycendent intellect would probably be unintelligible to Transcendent intellects and incomprehensible to humans.

Concept Ecosystems at the Polycendent level

A Polycendent intellect would be able to create “Transcendent equivalent” concept Ecosystems and large numbers of lower-level systems. Thus one or more Transcendent-equivalent beings could be simulated in a Polycendent mind, and many human-equivalent beings[42]. A polycendent intellect, like those at lower levels, would utilize such Concept Ecosystems to simulate, anticipate and explore scenarios, and then apply the results to real-world situations.

Externally, Concept Ecosystems could be utilized by polycendent intellect as semi-autonomous agents for dealings with sapient and Transcendent creatures. Whether via electronic form, robots, or other means, these agents would probably appear as “perfect” simulations (“the real thing”).

Using the external world to extend Polycendent intellect

Polycendent Intellect is likely to use the external world to extend its intellect in many ways, but Transcendent-level insights would probably be required to understand how this is done. There is speculation that polycendent wisdom might:

- “Create, manage and farm” natural systems as “auxiliary memory” and “auxiliary processing”.
- Run models and simulations using natural systems and mechanisms
- Offload non-critical processing and memory to Transcendent and lesser intellects.
- Utilize meme intellects as Concept Ecosystems

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[42] This is reminiscent of the “simulated people in a simulated world” theme that is popular with science fiction writers.

Chapter 9: Omnicendent Wisdom

("Knowing all")

The term Omniscience means "knowing all" but it is applied loosely in the label "Omnicendent Wisdom". Omnicendent Wisdom is 3 levels above humanity and it is the last of the conceptual levels[43]. It is defined as *structured Polycendent Wisdom* and by coarse analogy would differ from human intellect like human intellect differs from that of jellyfish.

It is not possible to avoid religious connotations when speculating on intellects operating at the Trans-, Poly- and Omnicendent levels (especially at the omnicendent level). However, the UTK assumes that all levels require physical "brains" with localized presence and operation. Therefore the classic attributes of godhood (non-physical body, omniscience and omnipresence) are not met. With the best of intentions, these issues are considered to be outside of the scope of the UTK and left for philosophers and theologians to consider.

Following the themes of previous chapters, the application of Omnicendent wisdom is called omniscient behavior which is likely to be unintelligible to all intellects up to the polycendent level. An omnicendent creature will "know" more than a polycendent creature and have greater precognitive abilities. Such abilities might span hundreds of years foward, with great accuracy[44]. A hypothetical creature with an intellect operating at Omniscient levels would, from a human perspective, appear to know everything, but this would not be so in the context of an infinite universe with infinite combinations of data, information, knowledge and wisdom.

Omnicendent wisdom's value range goes beyond pervasive precognition to an end-state called omniscience:

Value Range	**Examples:**
Non-omniscience	Multi-system events and outcomes not fully anticipated
Omniscience	All multi-system events and outcomes fully anticipated

It is assumed that intellect operating at the trans, poly- and omnicendent levels would utilize sensory "organs" and processing "nodes" spread across large volumes of physical space with human-equivalent (or higher) processes at the node level. For the purposes of discussion, a Transcendent intellect might have senses and intellect operating across cubic kilometers, Polycendent intellect might be planet-wide and Omnicendent intellect might extend across light-years of physical space.

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[43] Omnicendent wisdom is not necessarily a termination point for the series, but for the purposes of this document no additional levels are considered.

[44] The same processes for anticipating events years ahead, could be "run in reverse" to provide detail and insights into past events. Re-creations of multiple systems would probably go back the same number of years.

Concept Ecosystems and extensions of intellect

An intellect operating at the omnicendent level might use whole planetary systems as “auxiliary memory” and “auxiliary processing”. With the sophistication and complexity of concepts at the omnicendent level, an Omnicendent intellect would also be able to create “polycendent equivalent” Concept Ecosystems and (huge) numbers of lower-level systems. How these might be utilized by omnicendent intellect is an area of speculation left for interested readers to pursue.

Chapter 10: A comparison of intellectual levels

Side-by side, the levels of intellect range from small sets of abilities to large sets. Greater complexity of concepts, and processes, is implicit with each level and the abilities are set on an exponential curve. Human intellect is placed in the sapient level.

	Reactive	Instinctual	Intelligent	**Sapient**	Transcendent	Polycendent	Omnicendent
Anticipate event - Simple events			✓	✓	✓	✓	✓
Anticipate event - Complex events				✓	✓	✓	✓
Anticipate event - Very complex events					✓	✓	✓
Anticipate results & outcomes - Simple results & outcomes			✓	✓	✓	✓	✓
Anticipate results & outcomes - Complex results & outcomes				✓	✓	✓	✓
Anticipate results & outcomes - Very complex results & outcomes					✓	✓	✓
Art - Simple			✓	✓	✓	✓	✓
Art - Complex				✓	✓	✓	✓
Art - Very complex					✓	✓	✓
Avoidance behaviour	✓	✓	✓	✓	✓	✓	✓
Awareness - of external objects			✓	✓	✓	✓	✓
Awareness - of processes			✓	✓	✓	✓	✓
Awareness - of self			✓	✓	✓	✓	✓
Awareness - immediate environment			✓	✓	✓	✓	✓
Awareness - intra-system					✓	✓	✓
Awareness - inter-system						✓	✓
Awareness - multi-system						✓	✓
Awareness - social		✓	✓	✓	✓	✓	✓
Conceptual Ecosystems - Animal equivalent				✓	✓	✓	✓
Conceptual Ecosystems - Human equivalent					✓	✓	✓
Conceptual Ecosystems - Transcendent equivalent						✓	✓
Conceptual Ecosystems - Polycendent equivalent							✓
Control external processes & events			✓	✓	✓	✓	✓
Create industry				✓	✓	✓	✓
Create technology - low technology				✓	✓	✓	✓
Create technology - medium technology				✓	✓	✓	✓
Create technology - high technology				✓	✓	✓	✓
Develop strategies - Simple strategies			✓	✓	✓	✓	✓
Develop strategies - Complex strategies				✓	✓	✓	✓
Develop strategies - Very complex strategies					✓	✓	✓
Discriminate between past and present			✓	✓	✓	✓	✓
Discriminate between present and future			✓	✓	✓	✓	✓
Do agriculture, horticulture, aquaculture				✓	✓	✓	✓
Do animal husbandry				✓	✓	✓	✓
Emotions			✓	✓	✓	✓	✓
Entertainment				✓	✓	✓	✓

Farm				✓	✓	✓	✓
Instinct-based behaviour		✓	✓	✓	✓	✓	✓
Judge			✓	✓	✓	✓	✓
Kill other creatures	✓	✓	✓	✓	✓	✓	✓
Self Sacrifice & Kill self (knowingly)				✓	✓	✓	✓
Language written/symbolic - simple			✓	✓	✓	✓	✓
Language written/symbolic - complex				✓	✓	✓	✓
Language written/symbolic - very complex					✓	✓	✓
Language, any form of - simple		✓	✓	✓	✓	✓	✓
Language, any form of - complex			✓	✓	✓	✓	✓
Language, any form of - very complex				✓	✓	✓	✓
Memory -Short-term	✓	✓	✓	✓	✓	✓	✓
Memory - Long-term		✓	✓	✓	✓	✓	✓
Memory - Social and other forms			✓	✓	✓	✓	✓
Make objects			✓	✓	✓	✓	✓
Make Structures			✓	✓	✓	✓	✓
Mathematics				✓	✓	✓	✓
Painting, drawing			✓	✓	✓	✓	✓
Planning - Simple			✓	✓	✓	✓	✓
Planning - Complex				✓	✓	✓	✓
Planning - Very Complex					✓	✓	✓
Prioritise			✓	✓	✓	✓	✓
Problem solving - simple			✓	✓	✓	✓	✓
Problem solving - complex				✓	✓	✓	✓
Problem solving - very complex					✓	✓	✓
Religion				✓	?	?	?
Reproduce	✓	✓	✓	✓	✓	✓	✓
Science - low				✓	✓	✓	✓
Science - medium				✓	✓	✓	✓
Science - high				✓	✓	✓	✓
Seek nourishment	✓	✓	✓	✓	✓	✓	✓
Set values				✓	✓	✓	✓
Social behaviour - Sub human			✓	✓	✓	✓	✓
Social behaviour - Human equivalent				✓	✓	✓	✓
Social behaviour - Beyond human					✓	✓	✓
Sport				✓	✓	✓	✓
Tool create			✓	✓	✓	✓	✓
Tool use			✓	✓	✓	✓	✓
Translate language				✓	✓	✓	✓
Utilise external world to extend intellect				✓	✓	✓	✓

(This table should be regarded as an incomplete listing of intellectual abilities and mappings to the UTK levels.)

Traditional properties of knowledge such as “truth”, “certainty” and “accuracy” have been assigned as “value ranges” to the levels. The basis of this assignation is a simple ranking of the terms by perceived complexity and alignment with common-held views on their use. The value ranges used in the previous chapters are summarized below:

Value Ranges	Data	Information	Knowledge	Wisdom	Transcendent Wisdom	Polycendent Wisdom	Omnicendent Wisdom
Intellect	False to Accurate	Fiction to Factual	Uncertainty to Certainty	Non-Truth to Truth	Non-anticipation to (Limited) Precognition	Limited precognition to pervasive precognition	Non-Omniscience to Omniscience
Reactive	✓						
Instinctual	✓	✓					
Intelligent	✓	✓	✓				
Sapient	✓	✓	✓	✓			
Transcendent	✓	✓	✓	✓	✓		
Polycendent	✓	✓	✓	✓	✓	✓	
Omnicendent	✓	✓	✓	✓	✓	✓	✓

Chapter 11: Other Considerations - Meme Intellects

The main premise of this chapter is that a large and “close-knit” human society has the potential to sustain meme systems which are complex enough to function as intellects. It is postulated that human society development in the past hundred years has also accelerated the development of human-based meme intellects from the level of low-intelligence to high-intelligence. Technological, medical and social improvement of humans is expected to push human meme-based intellects to sapient-levels this century, with the possibility of self-awareness developing. If an exponential trend-line for development is assumed, higher levels may be attained quickly after.

A second premise is that meme-intellects are common – they appear in the natural world whenever the members of a species are social and engage in regular communications. With the great variety of animal[45] communities there are outward signs of many different reactionary, instinctual, and low- intelligence meme intellects.

The idea of a “super-organism” or “super-mind” which is the “sum-total” of the behaviors and characters of the members of a group, population or animal society is not new, but historically it has been vague and nebulous, often with inappropriate connotations. However, a practical brain-based analogy can be built by likening individuals to neurons, communications (visual, tactile, olfactory, sound etc.) as the connections between neurons, and systems of memes as the “processes and activities” of the neurons. The UTK provides a grading system for the end result, and this is the context for the term “meme intellect”.

With little or no specialization of its members, an animal species might produce meme intellects that operate at the reactionary level. Factors such as the complexity, nature and speed of communications, the count of individuals, and their life expectancies would affect the operation and abilities of the meme intellect: Improvement or degradation of these factors results in improvement or degradation of the meme intellect.

Just as individual neurons in a brain do not have any “sense” for the intellect they belong to, individual humans may not be aware of the meme-intellects they belong to[46]. Conversely, a meme-based intellect is not likely to be aware of its individual units of processing (human brains). Actions taken by a meme intellect for self-benefit, (whether it is self-aware nor not), are indirectly perceived or experienced as “social improvements” . Social security, health-care, education, child-care and community safety are obvious human examples. Broader “improvements in society” are also noted: Long-lasting permanent habitations, extension of activity periods (by electric light and telecommunications), secure food supplies and effective waste removal.

Geographical isolation of human populations, which in turn limits external communications, is assumed to produce separate human meme-intellects. Other forms of isolation – cultural, language, skin color and religious – are also assumed to produce separate meme-intellects. Thus many human-based meme-intellects could exist with differing capacities and abilities. Small, uneducated human communities are likely to produce instinctual meme-intellects and large educated societies are likely to produce intelligent meme-intellects. The question of "how intelligent" is open to argument, but the author has the opinion that human populations numbering hundreds of millions are needed for dog-equivalent intelligence (at present levels of technology). Contemporary observations suggest that some of the large American, Asian and European human populations (with high levels of education and prosperity) have meme intellects operating with intelligence.

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[45] The term animal used here includes insects and other invertebrates.

[46] Intellect is a sum-total of brain components and isn’t aware of individual neurons. A meme-based intellect may not be aware of its individual units of processing (human brains).

Can a single person be part of two or more meme intellects? The answer to this is considered to be "yes". Individuals carry many memes and meme-complexes which co-exist, usually without conflict. It's recognized that in any person a small number of meme complexes will dominate and limit (or block) others, but within such constraints, memes "shared" and "belonging" to different intellects can operate, This can occur at the same time, or at different times in a person's life

Activation, storage and processes relating to memes tend to relate to personal activity, and triggers via external influences. Consider an example of a deeply religious person employed in government. The religious meme complexes this person carries might be part of an *instinctual* religious meme-intellect. Non-religious meme complexes might be part of a *reactionary* governmental meme intellect. These complexes will dominate at different times in the person's weekly routine.

An important inference with meme intellects is that they have a "life-cycle" - going from a point of creation, through a period of growth and development, to a mature state, and ultimately demise. This is illustrated in the following example:

> *Start a herd with one bull and one cow (create a meme intellect), over time the herd grows (growth and development) and the herd numbers increase up to a point of nature-limited equilibrium (maturity). Finally, external factors such as disease, predation and environmental change might ultimately kill all of the descendents of the original bull and cow (death of the meme-intellect).*

This long-time, multi-generational aspect of the life-cycle has ramifications for how we consider human meme-intellects. It appears appropriate to say that a given human population experiencing growth and change has a "young" meme intellect and a static, "unchanging" population of humans has a mature or ageing meme intellect. Change and development of meme intellects spans human generations, and observation suggests that the "speed" of meme processes is slow[47].

Human meme intellects are different however to those of other animal species because of the enormous population growth and social changes of the past hundred years. Animal meme-intellects are limited by the mechanism of evolution, environment and population, but humans can change these factors. Human meme-intellects are also enhanced through feedback cycles of education, healthcare, technology and (improved) communications. This is elaborated in the table below:

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[47] Does this mean that meme intellects might take months or years to form a thought? Probably yes, but memes are subject to the pressure of competition and survival, so selection for "speed of thought" is likely to be a factor in the development of meme intellects.

Social improvement	Meme intellect impact
Education: • Expanding the number of ways to communicate. • Expanding the content and complexity of communication. • Precision, accuracy and quality of communications.	• Individual processing units communicate in more ways, with greater complexity. • More content communicated in less time. • Communications become more accurate and precise. • Units can quickly change to assume new roles. • Preservation of processes, standards and conventions.
Tools of sapience: • Libraries, patents, newspapers, magazines, recordings of sound and image. • Sub-tasking to machines and computers. • Mechanisms to speed-up communications	• Loss of individual processing units has less impact on the total system. • Stable and accurate long-term "memory". • Individual processing units able to achieve more, in less time, through technology
Improved life expectancy and health. Improved mental health.	• Larger populations of processing units, lasting longer, operating longer, at higher levels of efficiency. • Ability to repair or replace lost and damaged components. • Controlled population growth • Control of dysfunction
Improved resource management and improved infrastructure	• Denser, larger populations with less mobility. • Limiting damage caused by dysfunctional units. • Food supply needs and waste removal needs met • Enhanced communications via telephone, radio, television, internet and printed words. • Ability to mobilize processing units and resources in response to man-made and natural disasters.
Social organization into large organizations, business and government.	• Stable and durable decision-making structures. • Hierarchical decision trees. • Decision making is complex and

	sophisticated. • Decision-making components replaceable • Control, restraint and mitigation of social disruption
Specialization. New trades and professions, larger numbers in existing trades and professions.	• New, specialized processing to provide new abilities (e.g. the "I.T. industry") • Larger numbers of members in existing trades and professions equate to more/better input and output processing. • Individual processing units able to process more and make actions with wide-ranging effects.

There is the observation that computer technology and automation replace work previously done by people. This phenomenon is not causing a "de-humanizing" of human populations but it illustrates several important points about human meme-intellects (- points that further differentiate humans from other species):

- Human components readily integrate with non-human components
- Small portions of human meme-intellect can operate via non-human components
- Non-human components have decision-making roles[48]

Readers may be aware of a popular argument that near-exponential "growth curves" in technology and human (social) development will bring a "technological singularity" sometime this century. Proponents of this concept suggest that brain-machine integration, medical advances, artificial intelligence and sophisticated computer networks will improve to a point where, amongst other things, human intellect goes into the Transcendent level (and possibly beyond). The term "singularity" in this context refers to a developmental point at which human intellect (and society) becomes unintelligible by present-day standards.

There are also two related ideas. The same advances might:

- Accelerate artificial intelligence to human-equivalent, and then higher levels of intellect. Machine/computer -intellect might transcend before humans.

- Push human meme-intellects to Sapient levels, with the possibility of self-aware meme-intellects developing, and Transcendent meme intellects following.

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[48] This is a growing trend. From traffic lights to database systems.

These ideas are non-anthropocentric, but they have interdependencies that are likely to result in a hybrid result involving elements of mutual support and cooperation – benefits for one form of intellect ought to benefit the other forms. For example:

- A sapient human meme-intellect, might “improve” itself by forming meme-complexes that give education a higher social priority in the minds of its constituent human population.
- Human social harmony might be improved through durable conciliatory meme complexes.
- Human meme intellects might enhance human life and human intellect to aid their own development.
- Machine/Computer intellect could improve supply-chain logistics and manufacturing to benefit itself and humans.
- Advances in telecommunications would benefit humans, machine/computer intellect and human meme-intellects.

Further speculation on meme intellects and the “technological singularity” is outside the scope of this document, but interested readers should explore the variety of published books and articles on the subjects.

Part 2

A Conceptual Hierarchy

The UTK has a Conceptual Framework and a Conceptual Hierarchy. The conceptual framework is an adaptation of the “DIKW” model and was covered in part 1 of this document. The conceptual hierarchy is addressed in part 2 and integrates the conceptual framework into a hierarchy of concepts that abstract to the “known universe”.

Chapter 12: Introduction to the Conceptual Hierarchy

The Unified Theory of Knowledge (UTK) has the theme that knowledge varies with intellect and, through a series of intellect levels, concepts become more complex and sophisticated. This idea is consistent with observations of the natural world – creatures with simple brains utilize simple concepts and those with complex brains are able to deal with complex concepts.

The word "knowledge" is given two definitions in the UTK. In one, knowledge has a precise meaning as the product of structured information, and it is a defined level of conceptual complexity within the UTK, sitting above information and below wisdom. In the other definition knowledge is a generic term for the things that brains devote processing activity to. Generally this comprises:

- Sensory input
- Memories
- Concepts
- Awareness of processes occurring in the brain
- Awareness of self and personal states
- Material items such as documents, books, film, recordings, drawings, paintings etc.

This knowledge has two forms: Personal and social. Personal knowledge is the knowledge held by an individual's brain. Social knowledge is the adaptation and reproduction of personal knowledge into forms that can be communicated to others. It covers any form of communication between creatures with intellect. There are many types of communication including (but not limited to):

- Sound and speech
- Smell
- Body language
- Body shape and color
- Visual products/objects
- Aural products/objects
- Written products/objects

Scents, sounds, visual appearance, written words, pictures, theatre and dance are common examples. Such things can be ephemeral or long-lasting. Social knowledge also has the property of being *static* or *dynamic*: The term static is used in the sense of a communication that does not change (such as a photograph). The term dynamic applies to processes that are run, or repeated, and result in something being communicated.

Social knowledge is classified via many systems. The Dewey Decimal Classification (DDC) and the Library of Congress systems are well-known, with the DDC being, arguably, the most popular. For scientific and technical purposes there are specialized classification schemes, most of which are superior to the DDC in the areas they cover.

Fundamentally, all systems utilize a hierarchical approach to the classification/grouping of two or more of:

- Locations
- Objects
- Materials
- Concepts
- Processes
- Activities
- Forms of communication

Hierarchical approaches in classification seem to mimic the ways the human brain works: Concepts and memories are grouped together by brains via the common features they share, and groupings of groups occur whenever it is useful to do so. Every grouping is an abstraction of features, and "super-groups" easily form from thousands of layered concepts. This approach also doubles as an economical way to manage and store memories: Like the way telephone systems work, a concept for a group can be a trigger point for sub-concepts, each of which are trigger points for detailed concepts.

With the Dewey Decimal Classification system there are 10 classes, each in turn is divided into 10 divisions which divide further into 10 sections. This 10 x 10 x 10 hierarchy provides 1,000 subject areas, with rules for expanding the hierarchy further using decimal notation. DDC's historical design isn't necessarily the best for contemporary knowledge and media, but it is a practical (and popular) way of cataloging social knowledge. For this reason some of the classification principles of the DDC have been incorporated as sub-sets in the conceptual hierarchy of the UTK.

The following chapters are devoted to discussing the conceptual hierarchy further. Readers will note that the adaptations of common classification methods, with emphasis on showing the conceptual and intellect levels of the framework. In contrast to some schemes (like the DDC), there are no artificial restraints with decimalization and terminology is deliberately kept simple:

- Concepts branch downwards by levels;
- Higher levels are abstractions of lower levels;
- Any higher level can be called a conceptual category and its lower levels are concepts;
- The levels are optionally numbered, with one being the highest point of abstraction for the known universe and zero being the highest point of abstraction for the unknown universe. Levels are denoted with a stop between numbers (e.g. 1.4.8 denotes the 8th concept , 3 levels down via the 4th concept);
- The process of moving down levels is called decomposition.

The number of concepts per level grows in an exponential manner and this creates problems in reproducing them on paper. As a compromise, only key branches are detailed in the following pages.

Chapter 13: High level structures

The universe of concepts, in which all knowledge is placed, is itself a single concept abstracted as “The Universe”. This conceptual level requires no number, but the symbol for infinity is useful. “The Universe” branches into 2 levels referred to as “Known Universe” and “Unknown Universe”.

The “Known Universe” is referred to as level one .The “Unknown Universe” is referred to as level zero and regarded as *potentiality* for knowledge. It has uncertain structure, content and detail[49].

The “Known Universe” and the “Unknown Universe” decompose into all known and unknown knowledge respectively. The “Known Universe”, to which discussion will be devoted, has 3 branches which are the highest level of abstraction for their respective conceptual categories:

The Universe
- Unknown Universe
- Known Universe[50]
  - Forces
  - Constants
  - Objects

Forces are the forces that exist in the physical universe. Constants are the mathematical constants that apply to the physical world (such as pi, and the speed of light). Objects, the largest branch, comprise all of the things that make up the physical world (subatomic particles, radiation, atoms, elements, compounds, organic and inorganic objects, worlds, solar systems etc). Interactions between objects give rise to processes, and groupings of objects and processes are called systems.

The 3 branches of the known universe in level 1 expand to provide the next level of decomposition:

- Forces
  - Electromagnetic
  - Gravitational
  - Strong
  - Weak
- Constants
  - Large space constants (astronomical)

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[49] From a practical viewpoint, “Unknown Universe” can be used as a container for noted gaps in data, information, knowledge and wisdom. A hierarchy of levels that mirror those under the “Known Universe” would be a logical method for managing the noted gaps.

[50] Numbering has been intentionally omitted to save space. The “Known Universe” would appear as “1 Known Universe”, In the next level down, “Forces” would appear as “1.1 Forces”, “Constants” as “1.2 Constants” and “Objects” as “1.3 Objects”. In level 3 the branches are “1.1.1 Electromagnetic”, “1.1.2 Gravitational” , “1.1.3 Strong”, “1.1.4 Weak”, “1.2.1 Large space constants (astronomical)”, “1.2.2 Medium space constants (general physical)” etc.

        (List of constants omitted)
        E.g. Speed of light in a vacuum
        E.g. Permittivity of free space
    - Medium space constants (general physical)
        (List of constants omitted)
        E.g. Earth's gravitational acceleration constant
    - Small space constants (atomic/subatomic)
        (List of constants omitted)
        E.g. Avogadro's number
        E.g. Number of elements
    - Mathematical
        (List of constants omitted)
        E.g. Pi
- Objects
    - Objects of the physical world
    - Object interactions (processes and systems)
    - Objects of the intellect

The decomposition of Objects into the third level gives:

- Objects
    - Objects of the physical world
        - Bosonic zones (energy zones)[51]
        - Particles and aggregations of particles
    - Object interactions (process and systems)
        - Atomic and subatomic
        - Mass less objects
        - Elemental (same type) atoms
        - Molecular
        - Compounds
        - Systems
        - Bosonic (only) systems
    - Objects of the intellect
        - Fictional processes
        - Fictional narratives
        - Ideas, intent and purpose
        - Abstractions
        - Fictional object properties
        - Algorithms and processes
        - Objects without life
        - Mythical and fictional creatures
        - Spirits
        - Deities

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[51] A bosonic zone is a volume of space in which only photons and other bosons are found.

The branches “Objects of the physical world” and “Object interactions – Systems” (colored blue) are particularly important as repositories of “basic building blocks” for the physical world and intellectual domains.

- Objects
  - **Objects of the physical world**
    - **Bosonic zones (energy zones)**
      - **Types of zones**
      - **Aggregations of zones**
    - **Particles and aggregations of particles**
      - **Particles and anti-particles**
      - **Aggregations of particles**
  - Object interactions (process and systems)
    - Atomic and subatomic
      - *(list of concepts omitted)*
    - Massless objects
      - *(list of concepts omitted)*
    - Elemental (same type) atoms
      - *(list of concepts omitted)*
    - Molecular
      - *(list of concepts omitted)*
    - Compounds
      - *(list of concepts omitted)*
    - **Systems**
      - **Without Intellect**
      - **Of intellect**
    - Bosonic systems
      - *(list of concepts omitted)*
  - Objects of the intellect
    - Fictional processes
      - *(list of concepts omitted)*
    - Fictional narratives
      - *(list of concepts omitted)*
    - Ideas, intent and purpose
      - *(list of concepts omitted)*
    - Abstractions
      - *(list of concepts omitted)*
    - Fictional object properties
      - *(list of concepts omitted)*
    - Algorithms and processes
      - *(list of concepts omitted)*
    - Objects without life
      - *(list of concepts omitted)*
    - Mythical, fictional and imagined creatures
      - *(list of concepts omitted)*
    - Spirits
      - *(list of concepts omitted)*
    - Deities
      - *(list of concepts omitted)*

“Systems” under object interactions are divided into 3 conceptual areas: Systems without intellect, systems with intellect, and hybrid systems that combine intellect and non-intellect. Sub-branching of “Systems with intellect” gives the levels of intellect described in the UTK

- **Objects**
  - **Objects of the physical world**
    - **Bosonic zones** (energy zones)
      - Types of zones
        - *(list of concepts omitted)*
      - Aggregations of zones
        - *(list of concepts omitted)*
    - **Particles and aggregations** of particles
      - Particles and anti-particles
        - Anti-particles
          - *(list of concepts omitted)*
        - **Particles**
          - **Bosons**
          - **Fermions**
      - Aggregations of particles
        - Elemental Atoms (the elements)
          - *(list of elements omitted)*
        - Microscopic groupings of elements[52]
          - Amorphous
          - Balls
          - Crystalline (lattices)
          - Grains
          - Membranes, sheets
          - Meshes
          - Strands, threads
          - Tubes
          - Other shapes
        - Macroscopic groupings of elements
          - Dark Matter
          - Dust and gas clouds
          - Macroscopic orphan bodies
          - Nebulae
          - Quasi-stellar objects
          - Suns and associated bodies
  - **Object interactions (processes and systems)**
    - **Systems**
      - **Without intellect**
        - Artificial systems and algorithms[53]

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[52] Variously referred to as molecules, compounds and chemicals

    - Natural systems without life
        - Actions of forces fundamental
        - Actions by subatomic means
        - Actions by radiation, bosons
        - Actions by chemical means
        - Actions by electrical means
        - Actions by mechanical means
        - Actions by objects
        - Actions by object interactions

    - **Natural systems with life**
        - Library of life processes

          Standard processes such as glucose metabolism, DNA reading, biological clocks
        - Processes of life

          Actual processing, occurring at any time: Non-cellular, cellular, organ-based, body-based, and systems such as circulatory systems, digestive systems, excretory systems, immune system, endocrine system. Create sub-branches here to depict or model an individual creature's life processes.
        - Between organisms
        - Between organisms and non-organic systems
- **Of intellect**
    - **Memory (library of intellect)**
        - Memory templates
        - Sensory data input (memories of)
        - Data output and physical body
        - Bits
        - Data
        - Information
        - Knowledge
        - Wisdom
        - Transcendent memory
        - Polycendent memory
        - Omnicendent memory
    - **Processes of intellect**

      Actual processing, occurring at any time. Create sub-branches here to depict or model the intellect of individual creatures
        - Process templates

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[53] A general term for products of intellect

    - Inputs and pre-processing
    - Outputs of the brain (processes for)
    - Bit processes
    - Data processes
    - Informational processes
    - Intelligent processes
    - Sapient processes
    - Transcendent processes
    - Polycendent processes
    - Omnicendent processes
  - Between intellects[54]
    - By forces fundamental
    - By subatomic means
    - By radiation, bosons
    - By chemical means
    - By electrical means
    - By mechanical means
    - By objects
    - By object interactions
- **Combining Intellect and Non-Intellect**
  - Passive interactions
  - Controlled, directed interactions
  - Controlled, directed systems
- **Bosonic zone systems**[55]
  - Internal processes
  - Interactions with matter

A selective view of the branches that lead to the UTK levels is provided in diagram 5. Note that first definition of knowledge (referred to earlier) as “a collective term that describes the total of what a creature, or group of creatures with intellect knows”, is covered by the branch called “Memory” in the fifth level.

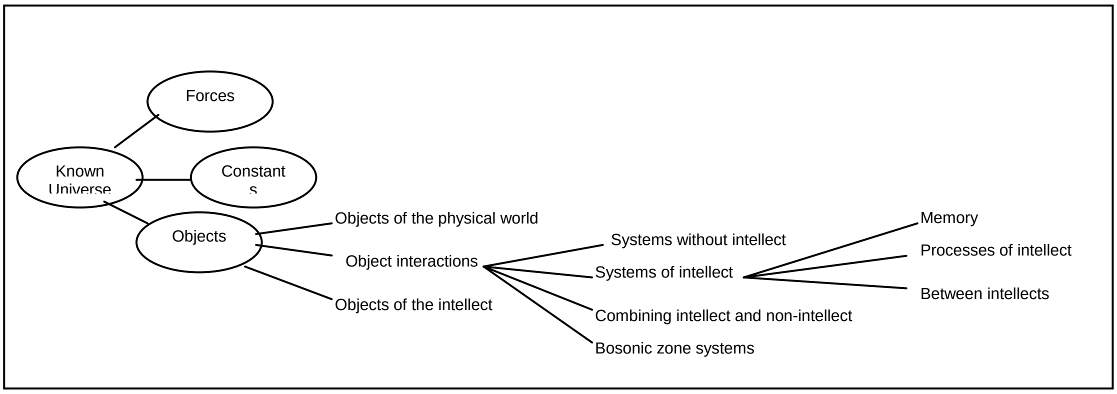

Diagram 5: Selective view of the first 5 levels

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[54] Comprising communications, social interactions, trade etc.

[55] It is speculated that in large volumes of space, multiple bosonic/energy zones interact in ways that can be referred to as systems.

Under the “Memory” branch, sub-branches relate to both ephemeral and long-lasting knowledge. There is an implied progression from simple to complex with “Sensory data input” being referred to as the first, or lowest, branch and “Omnicendent memory” as the last, or highest:

- **Memory**
  - Memory templates
  - Meta data, logs and indexes
  - Sensory data input (memories of)
  - Data output and physical body
  - Bits
  - Data
  - Information
  - Knowledge
  - Wisdom
  - Transcendent memory
  - Polycendent memory
  - Omnicendent memory

- Memory templates
  Generic structures to encode memories with and data symbolism rules
- Meta data, logs and indexes
  Meta data, rules, memories of operational conditions and states
- Sensory data input (memories of)
  Records of raw, and partly processed, data from the senses
- Data output and physical body
  Memories of what the physical body has done (movement, excretions etc.), plus memories of ‘standard” signals used to control the physical body (muscles, hormones etc).
- Bits
  Memories of bit (structured and codified signals typically from sensory cells.
- Data
  Groupings of bits: Memories of states, status and measurement.
- Information
  Structured data: Memories of objects, object relationships, properties, attributes, actions, activities and past experiences.
- Knowledge
  Structured information: Memories on how to do things, create, build, assemble, make, deconstruct (simple) analysis etc. Also memories on how to relate to others of the same species, and other creatures.
- Wisdom
  Structured knowledge: Values placed on outcomes and processes. Qualitative assessment and interpretations of experience. Logic, deduction, inferences, forecasts, morals, ethics etc.
- Transcendent memory
  Structured wisdom: Precognitive memories. Supersets of values on outcomes and processes. Very complex logic, deductions, inferences etc.

- Polycendent memory
  Structured Transcendent memory: Refer to part 1 of this document for further details.
- Omnicendent memory
  Structured polycendent memory: Refer to part 1 of this document for further details.

Readers should also note that systems of classification such as the Dewey Decimal System are placed under the "information" branch.

Under the "Processes of intellect" branch there are 9 branches relating to the levels of intellect defined in the UTK. These are for processes that work on the contents of corresponding "Memory" branches:

- **Processes of intellect**
  - Process templates
  - Inputs to the brain and pre-processing
  - Outputs of the brain (processes for)
  - Bit processes
  - Data processes
  - Informational processes
  - Intelligent processes
  - Sapient processes
  - Transcendent processes
  - Polycendent processes
  - Omnicendent processes

There is an implied progression from simple to complex with "Inputs and pre-processing" being referred" to as the lowest branch and "Omnicendent processes" as the highest. Implicit in this structure is that branches can utilize processes from lower branches, but lower branches cannot utilize processes from higher ones. There are special situations in which lower-branch processes can trigger higher-branch processes by producing outputs that higher-levels are "looking for".

- Process templates
  Generic structures to encode processes with. Also "standard processes" such as how to cause a muscle to contract, pattern recognitions and instinctual reactions.
- Inputs and pre-processing
  Processes for working with sources of data. Includes sensory inputs and processes for pre-processing ("re-working") the sensory inputs[56].
- Outputs (processes for)
  Processes for the physical body (movement, excretions, making sounds, storing memories etc)
- Bits (processes for)

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[56] Pre-processing is intended to cover data-level actions. Includes language recognition, interpretation of signs, body language etc. Also includes "hard-wired" instinctual processes such as "fear and flight" reactions.

Processes for the utilization of bitst (structured and codified signals typically from sensory cells.

- Data
  Processes for working with groups of bits that denote states, status and measurement.
- Informational processes
  When linked to output processes, cause instinctual behaviors. Processes such as data filtering, structuring data, relating data, synthesizing data. Examples are naming objects, ignoring irrelevant data, anticipation of direction, emotional associations.
- Intelligent processes
  Processes for structuring and working with knowledge. When linked to output processes, cause intelligent behavior. Processes to anticipate, create, build, assemble, make, deconstruct etc.
- Sapient processes
  Processes for structuring and working with wisdom. When linked to output processes, cause sapient behavior. Structured knowledge: Values placed on outcomes and processes. Qualitative assessments on experiences. Logic, deduction, inferences, forecasts, morals, ethics, judgments etc.
- Transcendent processes
  Processes for structuring and working with Transcendent wisdom. When linked to output processes, cause Transcendent behavior. Precognitive processes, superset valuation on outcomes and processes, very complex logic, deductions, inferences, associations, modeling etc.
- Polycendent processes
  Processes for structuring and working with polycendent wisdom. When linked to output processes, cause polycendent behavior. Refer to part 1 of the UTK.
- Omnicendent memory
  Processes for structuring and working with omnicendent wisdom. When linked to output processes, cause omnicendent behavior Refer to part 1 of the UTK.

Chapter 14: Low level structures of memory

In the previous chapter, the first five levels of the UTK's conceptual hierarchy were introduced. Two important sub-branches – "Memory" and "Processes of Intellect contain the levels of intellect of the UTK. This chapter provides further decomposition and discussion on the memory sub-branch.

The narrative of this chapter is mostly written for a single creature with intellect operating at the level of sapience[57]. Additional branches have been added to illustrate how non-human senses and processes might co-exist.

The "Memory" branch begins at level 5 and is a long-term repository of:

- Remembered sensory input,
- Processed sensory data, information, knowledge and wisdom, and
- Remembered data output

Sensory input comprises sensory bits usually provided by sensory organs in pre-processed form. For this reason the hierarchy does not begin with "sensory data" rather than "sensory bits". In a similar way, specialized areas of brains produce structured sets of bits to control muscles, glands etc., so intellectual output is referred to as "Data output and physical body".

Meta-data, information, knowledge and Meta wisdom are presumed to be important components of self-awareness[58]. Processes for these require indexes and logs that are placed under the branch "Meta data, logs and indexes".

It's also within the "information" branch" that adapted versions of classification systems like the Dewey Decimal Classification (DDC) system can be placed. Personal memories (such as images, sounds, smells, tastes, experience, past emotions, judgments and values) are spread across branches under bits, data, information, knowledge and wisdom.

Memory

- Memory templates[59]

  Generic structures to encode memories with and data symbolism rules
    - Sensory memory templates
    - Memory templates for internal processes
    - Output templates

---

[57] For the situation where more than one creature or intellect is represented, either put a branch per creature directly under "memory" and repeat the decompositions shown above, or put the branches lower down under "Information", "knowledge", "Wisdom" etc. Corresponding branches need to be created under the "Processes of Intellect" The first approach keeps separate memories and processes. The second approach gives shared memories and processes, with better support for conceptual ecosystems.

[58] Underpinning this view is the ability to compare present bits, data, information, knowledge and wisdom with past, then identifying what has changed.

[59] Templates presume hard-coded rules for the creation of memories. The rules themselves do not have to be remembered, or explicit.

    - Templates for recursive memories
- Meta data, logs and indexes

  Meta data, rules, memories of operational conditions and states
    - Awareness (memories of)
    - Data symbolism rules (for interpretation of inputs)
    - Indexes to branches of the conceptual hierarchy
    - Log of changed Bits and gaps in Bits
    - Log of changed Data and gaps in Data
    - Log of changed Information, and gaps in Information
    - Log of changed Input data gaps and gaps
    - Log of changed Output data and gaps
    - Log of changed Knowledge and gaps in Knowledge
    - Log of changed Wisdom and gaps in wisdom
    - Log of changed Transcendent wisdom and gaps
    - Log of changed Polycendent wisdom and gaps
    - Log of changed omnicendent wisdom and gaps
    - Rules for memory
    - Short-term memory of statii or inputs
    - Short-term schedules for output processes
- Sensory data input (memories of, past and current")
    - Code library for data input processes[60]
        - Physiological
        - Electrical
            - Analogue
            - Digital
    - Human data input
        - Of things smelt
        - Of things tasted
        - Of things touched
        - Of body states, conditions, moods, emotions
        - Of relative temperature
        - Of sexual, reproductive
        - Of things heard
        - Of things seen
        - Of orientation
        - Of weight and inertia
        - Of time, duration
        - Equilibrioception (sense of balance)
        - Pain (nociception)
    - Non-human data input
        - Echolocation
        - Magnetoception
        - Electroception

          Analog and digital signal reception (memories of)
        - Non visual infrared and other frequencies

---

[60] Data input processes are considered to be generic mechanisms in this model. The brain applies different sets of instructions to operate these mechanisms.

- Data output and physical body

  Despite the complexity of organic brains, most outputs are limited to muscular change, excretions, gland emissions and body-state changes. (Electrical outputs are included in this list to cover computer system outputs). This branch is intended to hold memories of output events, actions and processes, in the sense of "I remember contracting this muscle for 30 seconds" and "I tried to kick the ball using my leg and foot". Remembering (and reusing) data output is important for learning new skills, training the physical body and general feedback to the brain on the effectiveness of output signals.

    - Code library for data output processes[61]
        - Physiological
            - Muscular
            - Glandular
        - Electrical
            - Analogue
            - Digital
    - Outputs physiological (memories of, past and current)
        - Arbitration (memory of)

          Priority list and conflict resolution steps used in past and current data output.
        - Body state changes (memory of)

          Past states, conditions and *levels of alertness, arousal, excitement, change hormonal levels.*
        - Skeleto-muscular (memory of)

          Past positions, contraction sequences and states. Also memories of complex activities such as walking, climbing, grasping etc.
        - Speech and sounds (memory of)

          Speech and sounds made.
        - Physiological electrical fields (memory of)
        - Light emitting organs (memory of states and functions)
        - Excretion (memory of)
            - States and conditions of bladder
            - States and conditions of bowel
            - States and conditions of ear
            - States and conditions of hair
            - States and conditions of nasal systems
            - States and conditions of odor
            - States and conditions of sweat
            - States and conditions of tears
    - Outputs electrical (memories of)
        - Arbitration (memory of)

          Priority lists and conflict resolution steps used in past and current electrical output.
        - States and conditions of formatted data
        - States and conditions of data packets

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[61] Data output processes are considered to be generic mechanisms in this model. The brain applies different sets of instructions to operate these.

        - States and conditions of signaling
        - States and conditions of routing

- Bits

  This branch is intended to hold memories of Bits.

    - Code library for Bit processes[62]
    - Rules for changing Bit processes
    - Rules for changing Bit memories
    - Remembered Bits

- Data (internal)

  This branch is intended to hold memories of data that has been involved with internal processes

    - Code library for data processes[63]
    - Rules for changing data processes
    - Rules for changing data memories
    - Remembered Data

- Information

  This branch is best described as a "main library", personalized by the intellect that manages it.

    - **Code Library of Information processes**
    - **Rules for changing information processes**
    - **Rules for changing information memories**
    - **Emotions (classifications of emotions)**

      Anger, envy, fear, pride etc.

    - **On Regional Objects**

      Objects that have strong ties to geographic/physical locations.

        - Known Universe
            - Earth's galaxy (the milky way)
                - Earth's solar system
                    - Generalities
                    - Sun ("Sol")
                    - Planets and moons
                    - Mercury
                    - Venus
                        - Earth
                            - Earth's moon
                            - Planet Earth
                                - 550 Part 1Geology of the planet Earth

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[62] Bit processes are considered to be generic mechanisms in this model. The brain applies different sets of instructions to operate these.

[63] Data (internal) processes are considered to be generic mechanisms in this model. The brain applies different sets of instructions to operate these.

                        - 560 Paleontology, paleozoology
                        - 570 Life science
                        - 580 Botanical sciences
                        - 590 Zoological sciences
                        - Earth life (tree of)
                          Instead of DDC's classification system for plants and animals a modern taxonomic hierarchy is used.
                    - Mars
                    - Jupiter
                    - Saturn
                    - Uranus
                    - Neptune
                    - Pluto
                    - Asteroids, comets, meteorites
                    - Intra-solar space
                - Other star systems
                - Intra-galaxy space
            - Other galaxies
            - Non galaxy objects and zones
    - **Of Universal objects**
      Objects that could be found anywhere in the universe
        - 000 Information and Systems
        - 100 Philosophy, Psychology
        - 200 Religion
        - 600 Technology and applied science
        - 700 The Arts
        - 800 Literature
        - Universal sciences, mathematics
            - 500 Generalities
            - 510 Mathematics
            - 520 Astronomy and related
            - 530 Physics, mechanics
            - 540 Chemistry and related
            - 550 Part 2 Sciences of Geology
- Knowledge
    - Code library of knowledge processes
    - Methods of knowledge
    - Principles
    - Procedures
    - Processes
    - Relations
    - Rules and constraints
    - Records of experience
    - Personal knowledge (memory of)
        - Auditory spaces, locations, sources of sounds
        - Actions and events
        - Body states, positions, sensations

            - Feelings
            - Conscious use of body
            - People
                - Parents
                - Siblings
                - Relatives
                - Friends
                - Acquaintances
                - Social groups
                - Others
            - Schedules used for output processes
            - Words read, sounds heard
            - Subjective (personal time)
            - Visual space, locations
        - Personal standards and priorities
          Morals, standards, priorities, reactions etc.
        - Social knowledge
          How to do things, principles, ethics, laws etc
        - Rules for changing knowledge processes
        - Rules for changing knowledge memories
- Wisdom
    - Code library of Wisdom processes
    - Methods of Wisdom
    - Records of anticipated outcomes (predictions)
    - Records of judgments, opinions, feelings, impressions
    - Records of priorities
    - Records of values
    - Records of Concept Ecosystems.
    - Social and personal Wisdom
    - Standards for quality and excellence
    - Rules for changing Wisdom processes
    - Rules for changing Wisdom memories
- Transcendent memory
    - Code library for Transcendent Wisdom processes
    - Methods of Transcendence
    - Records of anticipated outcomes (predictions) for systems
    - Records of judgments, opinions, feelings, impressions
    - Records of priorities
    - Records of values
    - Records of partials[64] (Concept Ecosystems)
    - Records of memes and meme complexes
    - Discrete systems (memories of)
    - Rules for changing Transcendent processes
    - Rules for changing Transcendent memories
- Polycendent memory
    - Code library for Polycendent Wisdom processes
    - Methods of Polycendence

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[64] The term “partial” is borrowed from science fiction. It is used in the UTK to depict semi-autonomous ecosystems acting as representatives or agents of transcendent creatures.

  - Records of anticipated outcomes (predictions) for multiple large systems
  - Records of judgments, opinions, feelings, impressions
  - Records of priorities
  - Records of values
  - Records on avatars (Concept Ecosystems)[65]
  - Records of meme intellects
  - Multiple and large systems (memories of)
  - Rules for changing Polycendent processes
  - Rules for changing polycendent memories
- Omnicendent memory
  - Code library for Omnicendent Wisdom processes
  - Methods of Omnicendence
  - Records of anticipated outcomes (predictions)
  - Records of judgments, opinions, feelings, impressions
  - Records of priorities
  - Records of values
  - Records on Polycendent subsystems (Concept Ecosystems)
  - Records of meme intellects
  - Multiple and (very) large systems (memories of)
  - Rules for changing Omnicendent processes
  - Rules for changing Omnicendent memories

Chapter 15: Low level structures for intellectual processes

In previous chapters the high level structures for the UTK's conceptual hierarchy were introduced. Two important sub-branches – "Memory" and "Processes of Intellect" cover the UTK's levels of intellect. This chapter provides further decomposition and discussion on the sub-branch referred to as "Processes of intellect".

Whereas the "Memory" branch is a long-term repository of remembered sensory inputs, states, outcomes etc., "Processes of Intellect" is the "factory" of intellect. As an analogy it's convenient to think of "memory" as a large library of books containing public and private items, plus instructions on how do things, judge things and doing predictions (precognition). "Processes of intellect" take those instructions and operate machines elsewhere in the building. Sub-branches are like zones on the factory floor where different activities take place.

In addition to using the "Memory" branch, processes can also maintain "private" short-lived records of values, states, outcomes and suchlike to aid the activities they are involved in.

Processes of intellect

- **Process templates**

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[65] The term avatar is borrowed from religious literature. It is used in the UTK to depict semi-autonomous ecosystems that operate at the transcendent level.

Generic mechanisms for the execution of processes recorded in memory, instinctual processes and "hard-wired" processes.
Also processes for the management of memory

- **Inputs to the brain and pre-processing**

  Inputs are the signals, codes and status information provided by sensory organs and some regions of the brain.

  - Process Management and monitoring
    List of processes, status values, schedules, triggers, process execution, creation, modification, suspension, deletion.
  - Process Feedback, Monitoring, Reporting
    Checkpoint, status, inputs and outputs monitoring
  - Quality assurances
    Process inputs meet minimum requirements for processes, outputs meet expectations
  - Actual processes
    Classifying, documenting, codifying and standardizing inputs
    Current input values are processed and stored in short-term memory of inputs for use in informational, intelligent, sapient and higher-level processes. Also creating memories of the data used.
  - Current Input values
    Sensory organs provide current input values. Outputs from some areas of the brain also go here.
    - Human
      - Body states, conditions, moods (proprioception)
      - Equilibrioception (sense of balance)
      - Hearing (audition)
      - Orientation
      - Pain (Nociception)
      - Seeing, vision
      - Sexual, reproductive
      - Smelling (olfaction)
      - Tasting
      - Temperature (Thermoreception)
      - Time, duration
      - Touch (Tactition)
      - Weight and Inertia
    - Non-Human
      - Echolocation
      - Electroception (detecting electrical fields and signals)
        - Analog inputs
        - Digital inputs
      - Magnetoception (detecting magnetic fields)
      - Non-human-visible light frequencies

  - Output values (short-term memory of processed inputs)

Outputs from "actual processes" values are stored here to be processed into memories and to be used as inputs into informational, intelligent, sapient and higher-level processes.

- Human
    - Body states, conditions, moods (proprioception)
    - Equilibrioception (sense of balance)
    - Hearing (audition)
    - Orientation
    - Pain (Nociception)
    - Seeing, vision
    - Sexual, reproductive
    - Smelling (olfaction)
    - Tasting
    - Temperature (Thermoreception)
    - Time, duration
    - Touch (Tactition)
    - Weight and Inertia
- Non-Human
    - Echolocation
    - Electroception (detecting electrical fields and signals)
        - Analog inputs
        - Digital inputs
    - Magnetoception (detecting magnetic fields)
    - Non-human-visible light frequencies

- **Outputs of the brain (processes for)**

  Outputs are the signals, codes and instructions created by "hard-wired", instinctual, informational, intelligent, sapient and higher-level processes. These outputs are intended for organs, glands and muscles.

    - Process Management and monitoring

      List of processes, status values, schedules, triggers, process execution, creation, modification, suspension, deletion.
    - Process Feedback, Monitoring, Reporting

      Checkpoint, status, inputs and outputs monitoring.
    - Quality assurances

      Process inputs meet minimum requirements for processes, outputs meet expectations.
    - Actual processes for outputs

      Classifying, documenting, codifying and standardizing outputs intended for organs, glands and muscles.
      Current input values are processed and directed through "Outputs". Includes multi-step "hard-wired" reactionary

processes which can be influenced by changing input values[66].

- Current Input values

  "Hard-wired", instinctual, informational, intelligent, sapient and higher-level processes provide current input values. Outputs from some areas of the brain also go here.
  - Human
    - For organ control and change
    - For gland control and change
    - For muscle control and change
  - Non-Human
    - For control and change of skin color
    - For control and change of light-emitting cells
    - For control and change of electrical fields and signals)
      - For analog output
      - For digital output
    - For control and change of magnetic field producing organs
- Outputs

  Outputs from "actual processes" are directed through here. Glands, organs and muscles are stimulated or controlled, either directly or indirectly. Records of outputs are stored in memory.

- **Bit processes**

  - Process Management and monitoring
  - Process Feedback, Monitoring, Reporting
  - Quality assurances
  - Actual processes

    Fetching, checking, codifying, relating, creating, changing, removing, saving.
  - Current input values

    Requests to retrieve, store, change and delete memories from other processes and "Inputs to the brain"
  - Output values

    Outputs are long-term memories with defined context, links and relationships.

- **Data processes**

  - Process Management and monitoring
  - Process Feedback, Monitoring, Reporting
  - Quality assurances
  - Actual processes

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[66] Processes occurring within sensory organs, "reflex arcs" and other non-brain processes appear under the 4th level branch "Systems without intellect".

    Fetching, checking, codifying, relating, creating, changing, removing, saving.
    - Current input values
      Requests to retrieve, store, change and delete memories from other processes and "Inputs to the brain"
    - ▪ Output values
      Outputs are long-term memories with defined context, links and relationships.

- **Memory processes**
  For short and long term memory – creating and fetching memories. These processes mediate the conversion of signals that processes use to physically stored memories and visa-versa.

    - Process Management and monitoring
    - Process Feedback, Monitoring, Reporting
    - Quality assurances
    - Actual processes
      Fetching, checking, codifying, relating, creating, changing, removing, saving.
    - Current input values
      Requests to retrieve, store, change and delete memories from other processes and "Inputs to the brain"
    - ▪ Output values
      Outputs are long-term memories with defined context, links and relationships.

- **Informational processes**

    - Process Management and monitoring
    - Process Feedback, Monitoring, Reporting
    - Quality assurances
    - Actual processes
      Classifying, documenting, interpreting, codifying, standardizing, translating, filtering, merging, mapping, relating, creating, changing, removing, comparing, relating, linking, judging.
    - Current input values
      From other processes, memory processes and "Inputs to the brain"
    - ▪ Output values
      Outputs can go to memory, other processes, "Inputs to the brain" and "Outputs of the brain"

- **Intelligent processes**
  Applied knowledge

    - Process Management and monitoring
    - Process Feedback, Monitoring, Reporting
    - Quality assurances
    - Actual processes
        Classifying, documenting, interpreting, codifying, standardizing, translating, filtering, merging, mapping, relating, creating, changing, removing, comparing, relating, linking, judging.
    - Current input values
        From other processes, memory processes and "Inputs to the brain"
    - Output values
        Outputs can go to memory, other processes, "Inputs to the brain" and "Outputs of the brain"

  [Sapient and higher-level processes follow the structure of the "Intelligent processes" branch. "Actual processes" at any level can utilize same-level or junior-level processes as sub-processes, achieving (economical) complexity and sophistication. Junior-level processes generally have subservient roles[67]].

- **Sapient processes**
  Applied Wisdom
    - Process Management and monitoring
    - Process Feedback, Monitoring, Reporting
    - Quality assurances
    - Actual processes
    - Current input values
    - Output values

- **Transcendent processes**
  Applied Transcendent Wisdom
    - Process Management and monitoring
    - Process Feedback, Monitoring, Reporting
    - Quality assurances
    - Actual processes
    - Current input values
    - Output values

- **Polycendent processes**
  Applied Polycendent Wisdom
    - Process Management and monitoring
    - Process Feedback, Monitoring, Reporting

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[67] As a matter of speculation only, when a junior level process ignores the control mechanisms that a higher-level process sets, a "runaway" phenomenon might occur. This could be a repeating loop, or a non-terminating process. Both forms of "runaway" could range from being nuisances for the affected intellect to major consumers of intellectual resources. Conceptually, this idea has similarities to "obsessive behavior", "fixations" and "compulsive behavior" described in psychological literature.

    - Quality assurances
    - Actual processes
    - Current input values
    - Output values

- **Omnicendent processes**

  Applied Omnicendent Wisdom

    - Process Management and monitoring
    - Process Feedback, Monitoring, Reporting
    - Quality assurances
    - Actual processes
    - Current input values
    - Output values

Afterword

“It was like a shadow of a shadow – a miniscule hint that something was there. I decided to look the other way”.

Anon.

As I put finishing touches to this version of the UTK I find myself with mixed feelings about the theory (it’s like becoming a father for the first time after a two-year gestation period). The UTK seems to do a nice job in bridging the biological with the intellectual, and gives a workable structure for dealing with the diversity of intellect we humans encounter. The (hopefully) logical extension of certain traits of sapience into fully-developed features of higher-level intellects was a fascinating challenge and there was great temptation to follow several lines of thinking further.

I’m well-ware that the UTK is at odds with (some) dogma in epistemological, philosophical and psychological disciplines. Even AI enthusiasts might pooh-pooh the ideas in the UTK. Classic criticisms will be popular like “What does he really know?” and “Where are his credentials?” and “What circles of people does he mix in?”. My response is to say that I wrote the UTK as a project for my own benefit, and its only because colleagues suggested that I share it with others that I’ve done so. The way people use my words and my ideas is up to them and I’m not going to persuade them to change their beliefs or thoughts.

The basic message of the UTK remains: “Hey, if we think of all of these things in slightly different ways and stick to a structure with methods that build higher elements from lower elements then a whole lot of interesting things happen”. As I mentioned in the Foreword, the practical realities of circumstance, ability, family and work mean that my efforts will be less than what a professional could achieve, but I believe that the notion of a unified theory of knowledge, and the implications of such a thing, have great merit and may help those who are better placed to advance its ideas further.

Some of the implications of the UTK may disturb readers. I don’t think it’s appropriate to be apologetic, but I respond with the general observation that nature tends to produce more good things than bad things. I also caution readers that sapient viewpoints probably aren’t valid for transcendent and higher intellects.

The UTK does not align itself with any religion and I’ve tried to be careful to not offend religious readers. If however after going through this document you conclude a slur on your religious beliefs, then take my assurances that this was not intended. My excuse is that it was very hard to write without religions connotations on the topics covered in the UTK and any theory like the UTK cannot be “all things to all people”.

Some words on Memes: I learnt about memes and meme complexes in 2006 while doing research for the embryonic idea of “concept ecosystems”. Like a lot of others I was captivated by the ideas for memes and meme complexes, and I concluded that any unified theory of knowledge had to include them. This “marriage” of memes to intellect and knowledge worked quite well and naturally led to the idea of meme intellects. I honestly don't know if others have written about the same things– I've spent many hours checking for this without success - and I'll be the first to disown credit if other authors put their hand up and say they were first.

Finally it seems appropriate to leave some speculation for readers to ponder:

a) Meme intellects may exist in an intellectual version of the natural world. If populations of creatures produce meme intellects, what do populations of meme intellects produce? Is this a natural progression to other forms of intellect?

b) Certain thoughts and ideas don't occur in humans because they are blocked by memes?

c) Spontaneous conversations with strangers, often on odd subjects, might be exchanges between meme intellects

Peter Macpherson,
Saturday 24th February 2007.

Glossary of Terms

This glossary of terms is intended to supplement the two main parts of the document. As such, some of the terms vary from popular definitions and readers need to be careful in quoting them.

Artificial Intelligence (AI)
Artificial intelligence refers to systems designed and created by humans that have human-like intelligence. The scope if the term ranges from single-purpose “intelligent systems” to complex systems that emulate human thinking.

Bit
In the UTK a “Bit” is a solitary measurement, attribute, property or descriptor deriving from the structured and codified products of sensory (and other) signals. Bits are the building-blocks of concepts, and sets of bits become “Objects” that can interact with each other to produce “Processes”. Bits are:

- The raw ingredients of concepts;
- Components of data, and
- Analogous to subatomic particles.

Brain
Normal biological definitions apply for the concept of the “brain” .However the term can be extended to computer systems, or any other “system” exhibiting brain-like function. The concept of “brains” abstracts to physical objects that have specialized areas for:

- Sensory input;
- Maintaining body states;
- Processing and utilizing sensory input
- Doing things with the outputs of processes (moving, talking, eating etc.).

Class Name
Languages have words to describe groups of objects, processes and systems. Such words are referred to as “Class Names”.

Examples:

Class Name	**Members**
Color	Red, Yellow, Blue, Green etc
Temperature	Hot, Cold, Warm, etc.
Health	Well, Unwell, Fit, Unfit etc
Physical Appearance	Alert, Tired, muscular, tanned etc

Concept
Ideas and thoughts tend to be terms reserved for human intellect, so the term concept is favored in the UTK as a product of intellectual processes. The word “concept” is a multi-purpose term that denotes individual bits, groups of bits called objects and

interactions between objects and bits (called processes). Thus a set of bits can convey the concept of “redness”, another larger set can convey the concept of a “child” and a larger set that has objects interacting with one another can convey the concept of “building a house”.

Concept Ecosystems
It’s at the “Knowledge” level in the UTK that the idea of “Concept Ecosystems” has merit. A Concept ecosystem is one or more concepts, assembled by intellect, that interact according to rules/properties that the intellect applies. Like computer simulations, Concept Ecosystems can be regarded as mental processes that simulate (or model) aspects of real-life. Desired end points can be set by intellect and multiple scenarios can be explored to identify optimal results.

Simple Concept Ecosystems have roles in providing survival advantage for creatures with the intellect able to use them. In the example of a predator tracking down a prey animal, simple Concept Ecosystems in the predator’s brain are created to anticipate the behavior of the prey. Initially it may be a mix of trial and error, but the successful Ecosystems (successful hunting outcomes) will be favored. The predator’s brain can “snapshot” the starting patterns of the populations of neurons as a “memory” for future re-use.

Conceptual Framework
The UTK has a *Conceptual Framework* and a *Conceptual Hierarchy*. The conceptual framework proposes relationships between brain, intellect and concepts adapted from the “DIKW” hierarchical model.

Conceptual Hierarchy
The UTK has a *Conceptual Framework* and a *Conceptual Hierarchy.* The conceptual hierarchy integrates the conceptual framework into a hierarchy of concepts that abstract to the “known universe”.

Data
The components of data are bits which are structured and codified signals that originate from the sensory cells. Bits are grouped in data in ways that convey simple meaning. Data is also referred to as measurements, conditions, quantity, states and values. Intellect that operates at the “data-level” of conceptual complexity is said to be “Reactionary” and creatures with such intellect show simple, stimulus-driven (action-reaction) behavior

DIKW
Sometimes referred to as the “knowledge pyramid” or DIKW hierarchy (Data, Information, Knowledge, and Wisdom), the ideas are popular with information technologists, especially proponents of “knowledge management”. In the hierarchy, lower elements combine in recursive fashion into higher elements:

{”Data”➔”Information”➔”Knowledge”➔”Wisdom”}

Instead of using the term “pyramid” or “hierarchy”, the UTK uses the term “level”, but otherwise remains faithful to the main DIKW sequence. “Bits” and 3 new levels after “Wisdom” are added by the UTK. The DIKW hierarchy represents conceptual complexity only. Brain, Intellect,value ranges, conceptual ecosystems and memes are also included in the UTK.

Fact

The term "fact" has limited use in the UTK as the upper end of the value range for information. In common conversation, the term can refer to Bits, attributes of objects, processes or systems (or sets of these), accurate data and factual information. Generally, when a group of people mutually agree on the same or similar concepts, they refer to these as "facts".

Idea

A solution to a need, problem, or issue. Usually a narrative for a series of processes intended to achieve an outcome.

Information

Information is formally referred to as "Structured data" in the UTK. Information comprises groups, or sets, of data that have relationships assigned to them.

Intellect

Intellect is a collective term used in the UTK to refer to internal processes and functions of brains.

Knowledge

The word "knowledge" has two definitions in the UTK. In the first definition knowledge is a generic term *for anything that brains devote memories and processing activity to*. These processing activities produce personal and social forms of knowledge.

The second definition is more precise and refers to *a level of conceptual complexity that sits above that of "information" and below that of "wisdom"* (knowledge in this context is referred to as structured information).

Meme

When concepts are expressed in words, pictures, actions or by other means, this is referred to as "packaging". A packaged concept, ready for "cultural transmission" and intended to "have a life of its own" is called a meme. Memes are described by Richard Dawkins in his book "The Selfish Gene" (1976). Memes have the properties of self replication, mutation, life-cycles etc.

Meme Intellect

Animal societies are presumed to sustain meme systems which are complex enough to function as intellects. Meme-intellects are thought to be common – they appear in the natural world whenever the members of a species are social and engage in regular communications. With the great variety of animal[68] communities there are outward signs of many different reactionary, instinctual, and low- intelligence meme intellects.

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[68] The term animal used here includes insects and other invertebrates.

Object

There are three types of object; Objects made from Bits, Physical objects and Non-physical objects. Objects made from Bits are constructs of intellect used to represent both physical and non-physical objects. A physical object is anything that has form and discernable boundaries (attributes of length, width and depth plus existence in time).

Non-physical objects are conceptualizations that do not exist outside of intellect. Non-physical objects are similar to physical objects in the extent that they have form and boundary. Examples of non-physical objects are mythical creatures.

Polycendent Wisdom

Following the approach used with lower levels, Polycendent Wisdom is defined as structured Transcendent Wisdom. This level is two levels above the level of wisdom that humanity is placed in, and by coarse analogy the intellect of a creature with Polycendent Wisdom would compare to humans like human intellect compares to insects.

The term Polycendent is a composite term intended to describe intellect that is many times more complex than Transcendent intellect. The scope of Transcendent Wisdom is limited to large systems and their components, so polycendent wisdom is an expansion of this and covers “multiple large systems”. In practice this would involve huge numbers of memories and concurrent processes that give minute understandings of systems and interactions across them.

Omnicendent Wisdom

The term Omniscience means “knowing all” but it is applied loosely to the label “Omnicendent Wisdom”. Omnicendent Wisdom is three levels above humanity and it is the last of the conceptual levels. It is defined as structured Polycendent Wisdom and by coarse analogy would differ from human intellect like human intellect differs from that of jellyfish.

Precognition

Precognition is “knowing in advance” – a term that refers to the ability of complex brains to anticipate events and outcomes. Each level of the UTK has greater ability, with the higher levels possessing “long-term” precognition.

Process

When bits, objects and relationships change with time the result is called a process. Changes can be one-way, reversible, self-sustaining, decay and grow.

The term “process” describes the time-based interactions of bits, objects and other processes. Usually processes have a start and end point, plus one or more outcomes or products. Process types include, but are not limited to:

- Fixed length or duration
- Ongoing, perpetual
- Chain reaction
- Self-extinguishing

Record

Brains devote populations of neurons to the tasks of storing codified and structured signals to represent bits, objects and processes. These are referred to as records and they are re-used according to need. Intellects also use the external world to store records as “memory aids” and “supplemental memory”. The range of uses is huge - from the simple chemical markers used by insects to the sophisticated libraries used by humans.

Real-world

When an object or process has a physical existence, it is referred to as “real-world”. For example, leaves from a tree and thermonuclear fusion are real-world objects and processes respectively.

When an object or process has a non-physical existence, it is referred to as “non-real-world”. For example, mythical creatures such as centaurs and processes such as human teleportation are non-real-world objects and processes respectively.

Relationship

When sets of bits,data, information, knowledge and wisdom have common attributes, they are said to be related, or to have relationships.

System

A collection of bits, objects and processes that interact with each other .Systems can be large or small, simple and complex. An example of a small system is a desktop computer. An example of a large complex system is the weather. The UTK also applies the term system to sets of intellectual processes. When intellect simulates processes and systems, the specialized term “Concept Ecosystem” is used.

Transcendent Wisdom

Following the approach used with lower levels, Transcendent Wisdom is defined as structured wisdom. The term “Transcendent” has been taken from philosophical and religious literature where it variously means “excellent in all things”, “beyond human intelligence” and “spiritually advanced”. In the UTK “Transcendent Wisdom” is used without magical or religious connotations.

This level is not experienced by human intellect, but it has properties that extrapolate from those of wisdom. Readers should be mindful on the postulated exponential curve for brain, intellect and knowledge, so Transcendent Wisdom is not an incremental enhancement of wisdom - it is several times greater. A helpful analogy: Transcendent wisdom compared to wisdom might be like a comparing a university professor to a pre-school child.

Unified Theory of Knowledge (UTK)

The Unified Theory of Knowledge (UTK) concerns two definitions of knowledge and places them in a framework linking brains, intellect and concepts. Depending on the level of conceptual complexity an intellect operates at, there is reactionary behavior, instinctual behavior, intelligence or sapience. Concepts such as fact, truth, certainty, anticipation and precognition are incorporated as “value ranges” within the levels.

Eight operational levels have been developed in the UTK. Each level has greater complexity than its predecessor, and has more knowledge. This approach addresses the simple-to-complex brain types found in nature and provides a way to underpin terms for intellect and the elements of knowledge. Human intellect has been placed in the middle level. The first 5 levels cover the range of intellects found in nature and 3 levels are proposed which extend the series beyond human intellect.

Value Range

The challenge of incorporating traditional properties of knowledge such as “truth”, “certainty” and “accuracy” has been met in the UTK by assigning these terms as “value ranges” to the knowledge components of the operational levels. Dogs, for example, have a complex brain able to produce intellects that operate at the “intelligent” level. For knowledge at this level, the value range of intelligent concepts is said to be from uncertainty to certainty: Dogs can understand things to be certain, uncertain or somewhere in-between, but dogs do not understand higher-level values such as “Truth”.

Wisdom

Following the approach used with lower levels, wisdom is defined as structured knowledge. The UTK places human intellect in this level, with individuals being higher or lower than the mid-point. Other primate species are candidates for the lower-end of the range

Wisdom relies on remembered data, information and knowledge and includes abilities to manipulate each of these. Whereas knowledge links information by processes, wisdom links sets of knowledge. Wisdom derives abstract relationships from “cause and effect” situations, experience, anticipation and circumstance. Wisdom also applies values and judgments to relationships. Self-awareness is also regarded as a feature of this level. The scope of wisdom is limited to things that occur in small systems, but it touches upon the outcomes and anticipation of interacting systems (- this ability is further developed in higher levels).

Selected Reading and References

The UTK is a blend of ideas from the biological sciences, epistemological literature, physical sciences, library science and information technology. General texts on mind, brain, intelligence and knowledge in each of the fields can be readily found on the internet, and in printed form.

(As a word of caution, don't place greater importance on texts that have complex and verbose writing styles or those that require "leaps of faith or belief" on the part of the reader.)

A selected number of texts and references that were influential in the development of the UTK are listed below:

Dawkins, Richard; "The Selfish Gene" (Oxford University Press, 1989). ISBN 0-19-286092-5. Chapter 11 relates to memes. Also available at http://www.rubinghscience.org/memetics/dawkinsmemes.html.

Dewey Decimal Classification System: The official "Dewey Decimal System Home Page" is located at www.oclc.org/dewey/

Hall, William; "A Biological Theory of Knowledge, Foundation Literature and a Sketch" (http://www.hotkey.net.au/~bill.hall/a_biological_theory_of_knowledge.htm, 19 October 2004).

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Kurzweil, Ray; "The Singularity is Near" (Gerald Duckworth & Co.Ltd., 2005).ISBN 0-7156-3561-1.

Russell, Betrand; "Theory of Knowledge" for the Enclopaedia Britannica, 1926 edition.

Sharma, Nikhil; "The origin of the "Data Information Knowledge Wisdom" Hierachy" (http://www-personal.si.umich.edu/~nsharma/dikw_origin.htm, updated December 1, 2005)

Vinge, Vernor, What is the Singularity? The original version of this article was presented at the VISION-21 Symposium sponsored by NASA Lewis Research Center and the Ohio Aerospace Institute, March 30-31, 1993. A slightly changed version appeared in the Winter 1993 issue of "Whole Earth Review". A copy of the article was obtained from http://mindstalk.net/vinge/vinge-sing.html.

Several science fiction authors deserve credit for (creative) conceptualization of intellect beyond the human level:

Bear, Greg; “EON” (Published by Victor Gollancz Ltd, London 1986). ISBN 0-575-03861-6.

Bear, Greg; “Eternity” (Published byVictor Gollancz Ltd. 1980). ISBN 0-575-04613-9.

Vinge, Vernor; “A Fire Upon The Deep” (Published by Tom Doherty Associates, LLC, 1993). ISBN 0-812-51528-5.